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Miocene palynomorphs from lignites of the Soma Basin (West Anatolia, Turkey)

Kiyoshi TAKAHASHI* and Ulrich JUX**

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Summary

The intermontane Soma Basin of West Anatolia holds a key position as regards palynologic indication of its continental sequence of strata for the Miocene span of time. In pre-Neogene vales, which were framed by high mountains, a rather extensive sedimentary succession of approx. 500 m was accumulated; the section is composed of fluviatile and lacustrine rocks in both clastic and calcareous facies, including, however, several coal seams (lignites). Two depositional cycles, separated by an erosional phase, are to be distinguished. During the Late Neogene volcanic events caused such drastic changes in the local relief and drainage pattern that in Soma Dağlari the final stages of basin evolution no longer matched adjacent ones.

In consequence of the cyclic progress in sedimentation the section was stratigraphically subdivided in Soma and Denis Formations, with subsequently correlated Turgut, Sekköy and Yatağan Members. Meanwhile, these members have been radiometrically dated at sites near by and in other regions of West Anatolia. Accordingly, the Lower Coal Bed ($KM_{1,2}$) traces back to Late Burdigalian, the Middle Coal Bed (KM_3) most likely to Langhian-Serravallian and the Upper Coal Bed ($KP_{1,2}$) finally to Tortonian. As the section so far includes Early, Middle and Late Miocene units, their characteristics in both facies development and structural evolution seem to correspond quite well modern ideas on the regional geology of Anatolia.

A fossil microflora, rich in form species as well as individual specimens, was recognized in those samples taken from the three coal beds. This material occasioned a first comprehensive presentation of Miocene sporomorph assemblages from Soma Basin. Altogether 169 species were noted which refer to 59 form genera.

A good few of these palynomorphs, their essential characteristics, stratigraphic ranges, botanical affinities and synonymous taxa being described and listed, show such a long

* Department of Geology, Faculty of Liberal Arts, Nagasaki University, 1-14 Bunkyo-cho, 852 Nagasaki, Japan.

** Geological Institute, University of Cologne, 5000 Cologne 1, Zülpicher str. 49, Germany.

stratigraphical and wide regional distribution that they allow no definite dating. There were, however, certain species noted which not only support a Miocene age of the sedimentary sequence with the coal seams, but also mark out Early Miocene (Burdigarian) for the Lower Coal Bed ($KM_{1,2}$) and Late Miocene (Tortonian) for the Upper Coal Bed ($KP_{1,2}$).

The following 18 palynomorphs were recognized to be new species which accordingly had to be described with a diagnosis: *Laevigatosporites turcicus* n. sp., *Cedripites anatolicus* n. sp., *C. pseudodeodaraeformis* n. sp. *Piceapollis anatoliensis* n. sp., *P. minor* n. sp., *Ephedripites (Ephedripites) anatolicus* n. sp., *E. (E.) minor* n. sp., *Cupuliferoidaepollenites longus* n. sp., *Quercoidites somaensis* n. sp., *Retitrescolpites globosus* n. sp., *Striatopollis circularis* n. sp., *Tricolpites tecturatus* n. sp., *Tricolpopollenites anatolicus* n. sp., *Tricolporopollenites turcianus* n. sp., *Momipites somaensis* n. sp., *Tricolporopollenites moderatus* n. sp., *Ovoidites lanceolatus* n. sp., and *Schizosporis ellipsoideus* n. sp.

In addition to that emendation were considered to suit the following 7 species: *Piceapollis neogenicus* Nagy n. comb., *Pityosporites baileyanus* Traverse n. comb., *P. miocaenicus* Nagy n. comb., *Tricolpopollenites robusteus* Song, Li & Zhong n. comb., *Compositoipollenites denizliensis* Nakoman n. comb., *Intrabaculitricolporites ellipsoideus* Takahashi & Jux n. comb., and *Nyssapollenites kruschi* (Potonié) Nagy asp. *pseudolaesus* Potonié n. comb.

The coal seams of Soma Dağlari, exhibiting Early, Middle and Late Miocene sporomorph associations, serve not only as biostratigraphic markers for regional correlation of Neogene sections but also for the recognition of paleoecologic trends and paleoclimatic events. It turned out, that West Anatolia microfloras of Miocene age do reveal their own characteristics and are not easily compared with those of Central Europe. These lignites were not formed in open low land environments, instead, they arose in insufficiently drained mountain valleys from peats of boggy forests and gyttjas deposited on swampy grounds. Most likely, these marshy places were fringed by some bushwood which connected with extended areas of mixed forests along the hillsides. Proper stands of conifer trees did perhaps only flourish on top of the hills.

Sporomorph associations as they were recognized in three successive horizons of the Lower Coal Bed ($KM_{1,2}$) point at a gradual impoverishment of species diversities. This trend seems, however, to be reversed when the microflora of the Upper Coal Bed ($KP_{1,2}$) is considered.

To sum up, the mountainous area has highly influenced the composition of the fossil associations as can be concluded again and again from the pollen spectra presented.
Nevertheless, disappearances and new occurrence of certain palynomorph groups as well as sporomorph species—in particular among herbs and conifers—may be taken as a prelude of the decisive climatic changes of Late Neogene.

Zusammenfassung : Für die palynologische Kennzeichnung der kontinentalen Schichtenfolge nimmt im miozänen Zeitabschnitt das intermontane Soma-Becken Westanatoliens eine Schlüsselstellung ein. Die ca. 500 m mächtige Sedimentabfolge wurde in prämiozänen, von hohen Bergen umgebenen Talungen aufgestapelt; sie setzt sich aus fluviatilen uns lakustrinen Gesteinen in klastischer und kabonatischer Fazies zusammen, in denen aber auch mehrere Kohlenflöze (Lignithorizonte) vorkommen. Man kann zwei, durch eine Erosions-

phase voneinander getrennte Akkumulationszyklen unterscheiden.

In späten Neogen führten dann vulkanische Ereignisse zu derartigen Veränderungen der Reliefverhältnisse und Drainagesysteme, daß die einheitliche, regional weithin verknüpfbare Beckenentwicklung in Soma Dağlari abbrasch.

Das stratigraphische Profil wurde, den zyklischen Sedimentationsverhältnissen entsprechend, in Soma- und Deniz-Formation unterteilt, auf die sich Turgut-, Sekköy- und Yatağan-Schichten unschwer beziehen lassen. Für letztere liegen aus anderen Gebieten Westanatoliens mitterweile radiometrische Alterszuordnungen vor. Daraus folgert, daß das Untere Kohlenlager ($KM_{1,2}$) im späten Burdigal, das Mittlere (KM_3) wahrscheinlich im Langhium-Serravallium und schließlich das Obere ($KP_{1,2}$) im Torton entstanden ist. Da es sich also um eine alt-, mittel- und jungmiozäne Schichtenfolge handelt, scheinen die faziellen und strukturellen Merkmale in guter Übereinstimmung zu aktuellen Vorstellungen der regionalgeologischen Entwicklung Anatoliens zu stehen.

Aus Proben von den drei Kohlenhorizonten wurde eine arten- und individuenreiche Mikroflora bestimmt, die erstmalig zu einer monographischen Darstellung der Sporomorphen aus dem Miozänprofile des Soma Beckens Anlaß gab. Insgesamt sind 196 Arten festgestellt worden, die sich auf 59 Formgattungen verteilen. Viele der Palynomorphen, deren wesentliche Merkmale, stratigraphische Reichweiten, botanische Zugehörigkeiten und Synonymien erörtert werden, sind zeitlich und räumlich ziemlich weit verbreitet, so daß sie keine scharfen Zeitmarken setzen. Es wurden aber auch einige Arten festgestellt, die nicht nur das Miozänalter der gesamten, Kohleflöze enthaltenden Schichtenfolge unterstreichen, sondern für den Unteren ($KM_{1,2}$) und Oberen ($KP_{1,2}$) Kohlehorizont klar Alt- (Burdigal) bzw. Jungmiozän (Torton) abstecken.

Folgende 18 Palynomorphen werden als neue Arten aufgefaßt und entsprechend diagnostiziert: *Laevigatosporites turcicus* n. sp., *Cedripites anatolicus* n. sp., *C. pseudodeodaraeformis* n. sp., *Piceapollis anatoliensis* n. sp., *P. minor* n. sp., *Ephedripites* (*Ephedripites*) *anatolianus* n. sp., *E.* (*E.*)*minor* n. sp., *Cupuliferoidaepollenites longus* n. sp., *Quercoidites somaensis* n. sp., *Retitrescolpites globosus* n. sp., *Striatopollis circularis* n. sp., *Tricolpites tecturatus* n. sp., *Tricolpopollenites anatolicus* n. sp., *Tricolporopollenites turcianus* n. sp., *Momipites somaensis* n. sp., *Toriporopollenites moderatus* n. sp., *Ovoidites lanceolatus* n. sp. und *Schizosporis ellipsoideus* n. sp.

Außerdem waren bei folgenden 7 Arten Emendationen erforderlich: *Piceapollis neogenicus* Nagy n. comb., *Pityosporites baileyanus* Traverse n. comb., *P. miocaenicus* Nagy n. comb., *Tricolpopollenites robusteus* Song, Li & Zheng n. comb., *Compositoipollenites deniziensis* Nakoman n. comb., *Intrabaculitricolporites ellipsoideus* Takahashi & Jux n. comb. und *Nyssapollenites kruschi* (Potonié) Nagy asp. *pseudolaesus* Potonié n. comb.

Weil die Flözfolge in Soma Dağlari unter-, mittel- und obermiozäne Sporomorphen-Assoziationen aufweist, sind diese nicht nur bedeutsam für regionalgeologische und biostratigraphische Vergleiche, sondern auch für die Aufhellung paläoökologischer Vorgänge und paläoklimatischer Ereignisse. Es stellte sich heraus, daß die westanatolischen Mikrofloren aus dem Miozän durchaus eigene Züge aufweisen und nicht ohne weiteres auf mitteleuropäische bezogen werden sollten. Die Braunkohlen entstanden nämlich hier nicht im offenen Flachland, sondern gingen aus Bruchwaldtorfen und Sumpfgyttjen hervor, die in tiefen, zeitweilig aufgestauten Gebirgstälern unter feuchten, warmtemperierten Klimabedingungen abgeöagert worden waren. Die sumpfigen Niederungen wurden wohl nur von schmalen Buschstreifen eingefaßt, die aber in ausgedehnte, die Berghänge überziehende Mischwälder überleiteten. Geschlossene Nadelgehölze gab es wahrscheinlich nur auf den Höhen.

In unteren Flözhorizont ($KM_{1,2}$) deuten Sporomorphen-Assoziationen aus drei unterschiedlichen Niveaus eine allmähliche Florenverarmung an. Offensichtlich ist im oberen Flözhorizont ($KP_{1,2}$) die Tendenz eher umgekehrt gewesen. Insgesamt zeight sich jedenfalls in den Pollenspektren aus der Kohle von Soma Dağlari immer wieder, welch großen Einfluß die Gebirgslandschaft auf die Sporenassoziationen ausübte. Immerhin könnte das Verschwinden und Neuerscheinen von bestimmten Palynomorphen-Gruppen oder Sporomorphen-Arten, insbesondere bei Kräutern und Koniferen, ein Vorspiel der einschneidenden klimatischen Umbrüche im späten Neogen gewesen sein.

Introduction

The economic potentials of lignite deposits which occur in the region of Soma, halfway between Akhisar and Bergama in western Anatolia, stimulated first geological investigations. This brought forth a set of valuable reports and scientific publications, which of course focus on stratigraphical, structural and economic topics. Once the rock units had been classified in general terms (Kleinsorge 1941), more detailed biostratigraphical investigations were to follow, ending up in a regional correlation of characteristic magna facies (Nebert 1959, 1960, 1978; Becker-Platen 1970).

In Soma Dağlari Tertiary sequences of strata may attain a maximum thickness of approx. 1000 m, being divided into Soma and Denis Formations (Nebert 1978). Within the section three horizons are characterized by either more locally restricted or regionally developed intercalations of dark carbonaceous clay together with exploitable lignites. Actually, only Miocene deposits are worked in the mines of Soma Dağlari, producing altogether approx. 6.5 mill. tons of coal at reasonable costs. Most of it supplies a modern power plant.

Mining concentrates on the Lower Coal Bed ($KM_{1,2}$) in the section. This horizon is noted to be a reliable marker bed for stratigraphic correlation with the sedimentary fill of adjacent Neogene basins, namely the stratigraphic boundary between Turgut and Sekköy Members (Becker-Platen 1970). A pyroclastic layer just above the seam revealed a radiometric age of 17.3 ± 0.4 Ma (Becker-Platen et al. 1977) corresponding with Early Miocene (=Late Burdigalian). With this information biostratigraphic units, otherwise dated either by vertebrate remains (Aragonian: Sickenberg 1975) or palynomorphs (Eskihisar pollen assemblage: Benda 1971; Benda & Sickerberg 1975) were brought into both stratigraphic connection and biotic comparison.

This in mind, one may refer to the almost synchronous shifts of Neogene magna facies which happened to occur in the continental sedimentary basins of western Anatolia (Alpen & Lüttig 1971), when both Tethyan paleogeography and Neogene paleoclimatology were severely effected by the Late Miocene closure of the Gibraltar strait. This commonly commented event not only caused desiccation of Mediterranean waters and lowered salinities in cooling oceans but also, in respect to Anatolia, increased relief energy besides decreasing rates of precipitation.

The impact of plate collisions between Africa and Eurasia which evidently triggered these and other changes is echoed by the assemblages of fossil vertebrates discovered in Mio-Pliocene deposits of Turkey and which are grouped into a dozen biozones. Zoogeographic relations with Central Asia in particular, but also India, Africa and Middle Europe are evident at once (Sickenberg & Tobien 1971). Yet palynologic investigations proved also to be very effective tools for the biostratigraphic indication of these Neogene deposits. However, instead of proper index fossils community changes were emphasized in order to visualize disturbed or new arrangements in the fossil record of vegetational patterns.

Using this method, the above mentioned Lower Coal Bed ($KM_{1,2}$), yielding at first just 8 identified and 14 other species of dispersed sporomorphs (Benda in Brinkmann et al. 1971; Benda 1971), matches the "pollen assemblage of Eskihisar", said to be notably marked by quercoid (*henrici-microhenrici* group) and pinacean pollen (*haploxylon* type). Nevertheless, a more detailed study of this palynoflora, including brief descritions of meanwhile 42 species, was recently performed on material which derived from the Evciler coal field (Akgün et al. 1986). This mining area is situated approx. 8 km NE of Soma city and 3 km to the West of Denis village. According to this investigation the spectra, compiled from the seam at the stratigraphic boundary between Turgut and Sekköy Member($=KM_{1,2}$)and the one in Sekköy Member($=KM_3$) are almost identically composed, obviously without showing tendencies of Benda's "Yeni Eskihisar pollen assemblage".

Now, results are presented of a first comprehensive investigation of palynofloras derived from those three coal beds which are exposed in Soma Dağlari proper. The research topic was stimulated in the course of a more fortuitous excursion which in fall 1988 was kindly organized and guided by mining geologists of the Soma-Manisa coal fields, first of all by Dr. Orhan M. Solmaz. Thanks are expressed not only for the support in obtaining adequate samples but also for the qualified informations on local stratigraphic peculiarities as well as structural complications.

Structural outlines

The evolution of large continental basins mark temporary diminuations of major crustal movements in Anatolia, which were initiated by Kimmerdian and Alpine orogenies. As a consequence of this the African and European Plates had collided perhaps as early as Late Cretaceous (? Campanian), although the circumglobal equatorical circulation of oceanic waters was for a long time not yet interrupted. At the dawn of the Neogene, however, when Arabia had separated from Africa and drifted further north, this situation took place conjointly with a westward move to Anatolia. The microplate was squeezed on the one side along the Dead Sea-Aquaba transform fault and on the other along the North Anatolian wrench fault systems (Fig. 1). Therefore, the Pontine Mountains are much closer to the Tauric Chain in the east than in the west where graben structures point at tensional and not compressional stress fields.

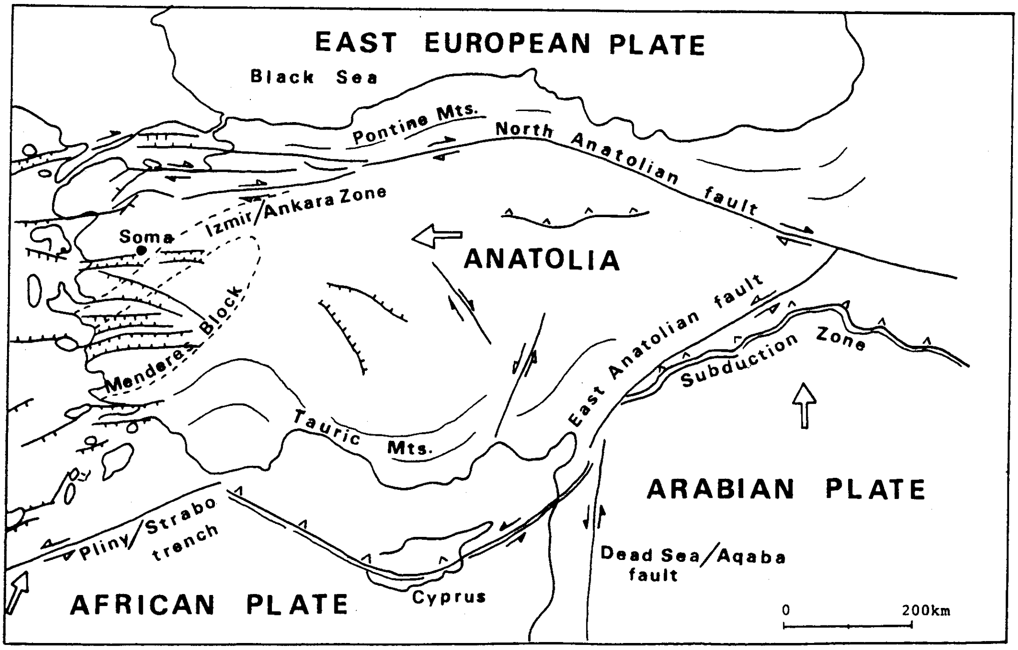

Fig. 1. Global tectonics of Anatolia and structural position of Soma Basin.

Compared with the huge Anatolian basins, which gathered at first marine and then continental sediments of varying facies since Late Cretaceous time, the Soma trough was rather lately incorporated into lowland dynamics. Situated on the northwestern flank of the Menderes Massif and the adjacent, highly disturbed Izmir-Ankara Zone, neither Cretaceous nor Paleogene rocks have been preserved in Soma Dağlari. Most probable this is due to a long period of regional uplift which may trace back to Kimmeridian(=Eohellenic), at any rate, however, to Early Alpidian movements. In this region the Mio-Pliocene rocks are altogether of continental facies, either fluviatile, lacustrine or even volcanic. But in spite of its apart position this rather diversified sequence revealed very similar characteristics in litho- and biofacies when compared with those of other sedimentary basins in West Anatolia (Becker-Platen 1971; Sickenberg & Tobien 1971; Benda 1971). In fact, the major cycles of limnic sedimentation which elsewhere succeeded the accumulation of molasse deposits during Miocene and Pliocene are also recorded here.

Anatolian basins expanded into Soma Dağlari not until the end of Lower Miocene. Therefore, in this region the course of former rivers as well as the position of contemporaneous lakes and peat bogs are particulary evident in certain parts of the sections. The ancient drainage system deciphers in fact a NE-SW orientation of the Paleozoic-Mesozoic basement and its structurally controlled paleomorphology. Lasting subsidence enlarged the sedimentary trough to an extent that relief boundaries faded away. Thus, a marginal aggrandizement is easily recognized by the gradual overlap of its younger fill. Deep seated Lower Coal Bed, not extending more than 2-4 km in E-W direction, was bound to be accumulated in the lows of an old valley, where now three mines (Garb L. i, Kaolin and Emas) are lined up from NE to SW (Fig. 2). Contrary to this situation, the Late Neogene lucastrine deposits have a much wider lateral distribution (6-8 km from east to west), although the inherited NE-SW direction of the sedimentary basin was strictly maintained (Brinkmann et al. 1971).

Limnic sedimentation ceased in the basin already by the end of Miocene, when volcanic eruptions had altered the scenary to quite an extent. Then, erosional activity was reactivated in combination with reinforced crustal unrest. This provoked considerable destructions in Soma Dağlari. Subsequently vertical displacements to more then 800 m were effected along predominant faults which strike NE-SW, NNE-SSW and almost N-S (Brikmann et al. 1971).

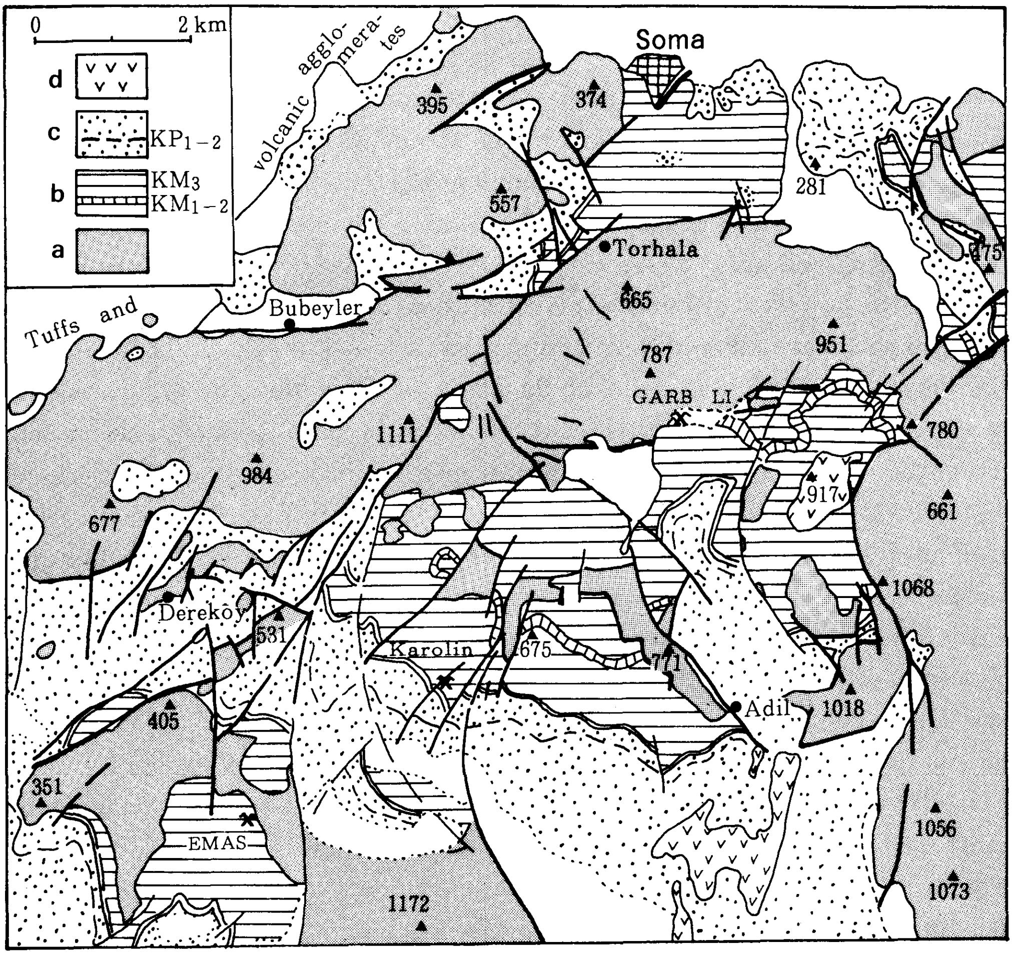

Fig. 2. Neogene basin deposits in Soma Dağlari (modified after Brinkmann et al. 1971).

a: Late Paleozoic & Jurassic basement rocks

b: Miocene Soma Formation; $KM_{1,2}$ Late Burdigalian Lower Coal Bed; KM_3 Serravallian-Langhian Middle Coal Bed

c: Late Miocene Denis Formation; $KP_{1,2}$ Tortonian Upper Coal Bed

d: ? Old Quaternary basalt

Sequence of strata

Highly faulted and rather dissected Paleozoic sandstones and shales (Carboniferous to Permian) as well as Mesozoic conglomerates, limestones and radiolarites (mostly of Late Jurassic age) are the substrata of Neogene sediments. These are preserved in a pronounced paleorelief which orginated from both tectonic deformation and subaerial weathering. The Jurassic rocks tower up to form high mountains whereas deeply eroded Paleozoic clastics define the course of former drainage and ancient topographic depressions.

Createceous deposits have not been identified so far and there are also no hints that considerable sedimentation took place during the Paleogene. As a consequence, there is a significant disconformity between rather unconsolidated, yet tilted and faulted Neogene bed rocks and the predeformed basement complex.

During the Neogene the old vally floors were burried below hill slope debris and fluvio-lacustrine deposits progressively being incorporated into enlarging troughs. In a comprehensive view the Neogene section is easily distinguished by its cyclic sequence of limnic sediments, starting with fluviatile gravel or sand with subsequent peaty deposits and ending up with lacustrine clays or marls. From this resulted a lithostratigraphic subdivision into two formations, each of them embracing several members (Kleinsorge 1941; Nebert 1959, 1978; Brinkmann et al. 1971; Becker-Platen 1970). A brief review of the sequence of strata may inform on the essential features, i. e. the vertical changes in the regional facies pattern (Fig. 3).

Soma Formation(Nebert 1978, Akgün et al. 1986)

Turgut Member (Becker-Platen 1971)

Basal Unit – M_1 (Brinkmann et al. 1971): Compact clay with intercalated gravel (components: radioarite, sandstone, limestone) and sandy clay, varying in thickness according to the paleorelief; at the top of the unit silicified stumps of trees, which may still be rooted in their former substrate.

Lower Coal Bed – $KM_{1,2}$ (Brinkmann et al. 1971): Dense, in part bituminous and well bedded pitch coal with dark clayey layers at the base and in the middle part of the unit. The thickness of the seam, which is in fact one of the main sources of coal production in western Anatolia, reaches a maximum of approx. 20 m in the open working mine at Garp L. i. to the south of Soma city (Fig. 4: C). Further south and northward of the mining district its thickness is reduced considerably. Near Eynez (approx. 10 km SW of Garb L. i.) the Lower Coal Bed is certainly missing but 8 km to the NE of Soma city it is again a main producer in the Evçiler mining field (Akgün et al. 1986).

On top of $KM_{1,2}$ seam, one or several layers of volcanic ashes, up to 20 cm thick and composed of quartz, plagioclase and biotite, were recognized (Brinkmann et al. 1971). Actually, this appears to be the very level which

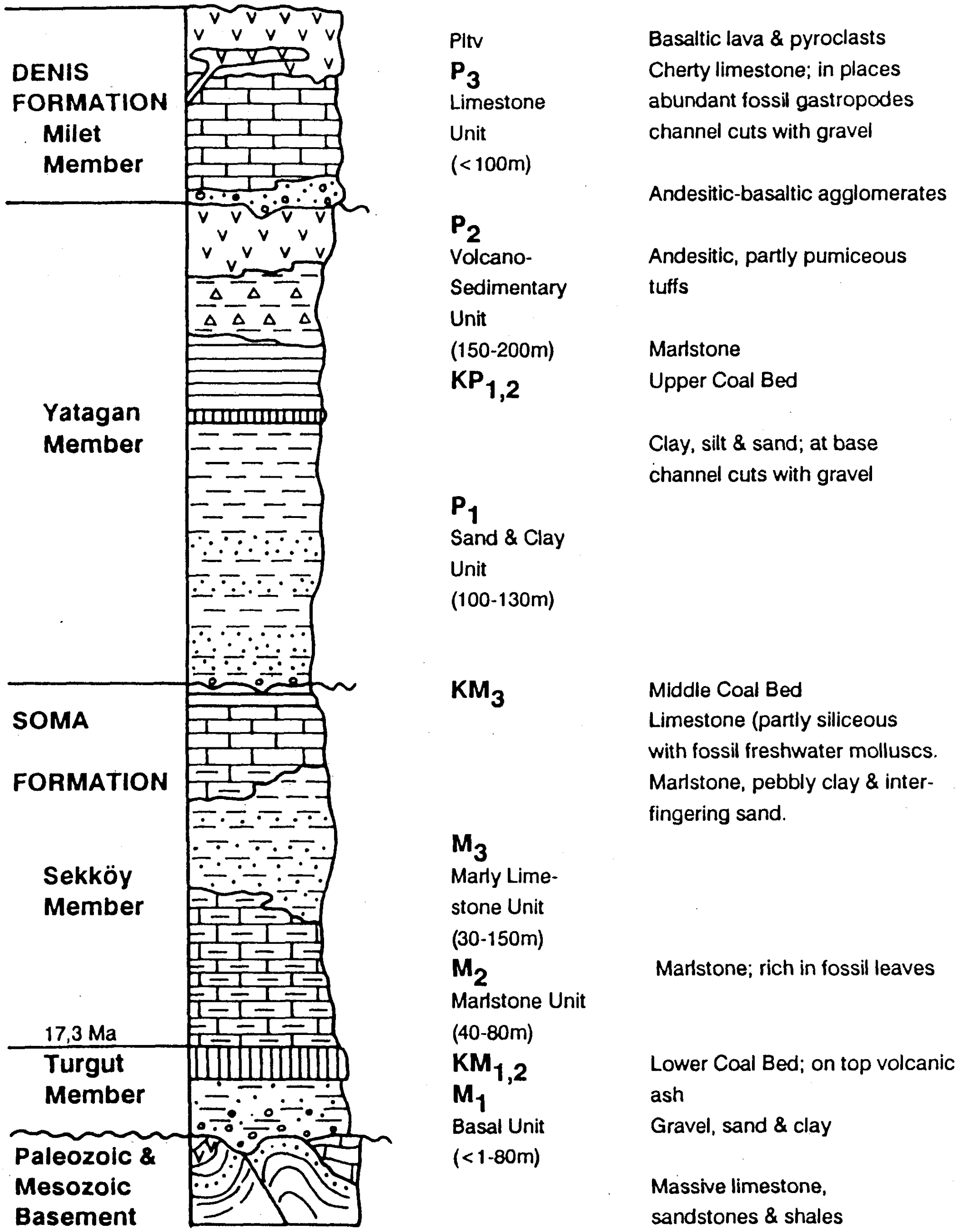

Fig. 3. Stratigraphic column of Neogene rock sequence in Soma Dağlari. Radiometric dates denote Late Burdigalian for Turgut Member, Serravallian-Langhian for Sekköy Member and Tortonian for Yatağan Member (Becker-Platen 1971).

could be radiometrically dated at the former coal mine near Belenyenice revealing an age of 17.3±0.4 Ma (Becker-Platen et al. 1977).

Sekköy Member (Becker-Platen 1971)

Marlstone Unit – M_2 (Brinkmann et al. 1971): Well bedded, bluish gray marlstones with some buff limestone layers, attaining a thickness of 40–80 m. Bedding planes may be covered by the impressions of fossil leaves and shoots of ? *Podocarpus* sp., *Glyptostrobus* sp., *Pinus* sp., *Quercus* sp., *Salix* sp., *Alnus* sp., *Cinnamomum* sp..

Marly Limestone Unit – M_3 (Brinkmann et al. 1971): Fine to thick bedded, light grey lacustrine limestones dominate the section, although marlstone and claystone interfinger. In the upper part of the unit, which is 30 to 150 m thick, the limestones may be silicified. Otherwise, they are often oolithic and oncolithic, yielding abundant freshwater fossils such as pelecypods (*Sphaerium* sp,), gastropods (*Lymnaea* sp., *Planorbis* sp.) and ostracods (*Miocyprideis* sp., *Candona* sp.). A more detailed list is given by Brinkmann et al. (1971).

Middle Coal Bed – KM_3 (Brinkmann et al. 1971): This seam is relatively thin (4–6 m) but also composed of compact, platy pitch coal, which commonly alternates with clay beds. Therefore, the economic value of exploiting the horizon is much lower than working $KM_{1,2}$ seam. Marly deposits which are preserved on top of the Middle Coal Bed are truncated by an erosional surface. This in fact marks the termination of Soma Formation (Fig. 4:B).

Denis Formation (Nebert 1978, Akgün et al. 1986)

Yatağan Member (Becker-Platen 1971)

Sand & Clay Unit – P_1 (Brinkmann et al. 1971):The oldest deposits of this member are sand and gravel, commonly exposed in channel fills. They are overlain by a 100 to 130 m thick succession of fluviatile and lacustrine, weakly cemented sands with clay, silt and gravel intercalations.

Upper Coal Bed – $KP_{1,2}$ (Brinkmann et al. 1971): Due to partial erosion this horizon can not be traced for sure in the Evçiler mining district (Akgün et al. 1986) although otherwise it is a good stratigraphic marker in Soma Dağlari. As the lignite seam is clayey and generally thin (0.5–1 m) its mining did not pay with one local exception near the southern rim of the basin at Eynez (Fig. 4: A).

Volcano Sedimentary Unit – P_2 (Brinkmann et al. 1971): This mixed sequence of rocks amounts from 150 to 200 m, commencing with grey carbonaceous marlstones. Andesitic pyroclasts occur at first in lenses and thin layers; they concentrate in a distinct horizon of light grey, partly pumiceous tuffs, which again are covered by andesitic agglomerates. This volcanic episode


A


B
B


E.L.I. 5
C

had ceased when sandstones and gravel beds were at last deposited above.

Milet Member(Becker-Platen 1971)

Limestone Unit – P_3 (Brinkmann et al. 1971): The uppermost part of the Neogene section consists of well bedded, white to yellow limestones which are in part silicified, containing both layered and concretionary chert. Aboundant remains of pulmonate gastropods prove another lacustrine phase of sedimentation.

This easily recognized unit is not preserved in the Evçiler coal field (Akgün et al. 1986). In Soma Dağlari an erosional surface cuts also this unit and points at subaerial exposures until the eruption of volcanic agglomerates, andesitic pyroclasts and basaltic lavas (Pltv) substantially modified local refief. After all, this volcanic overburden preserved the Neogene section below from further destruction.

Composition of lignites

In the course of coalification the originally peaty and oozy deposits altered considerably to become dense, bituminous lignites ranking among pitch coals. There is a definite relation between both technical and chemical properties of these coals when compared in the sequence of their respective stratigraphic position. Concerning its technical use, $KM_{1,2}$ coal (40% tar, 5–15% ash) has a heating power of 4600 Kcal/kg, whereas KM_3 coal (10 – 20% ash) yields not more than 2800 Kcal/kg (Brinkmann et al. 1971).

Depositional depth of the lignites certainly controlled in the most the grade of coalification. This is noted in the vitrinite reflectances which significantly increase downward the section (Tab. 1).

Fig. 4. Miocene lignites exposed in the coal fields of Soma Dağlari at Some-Manisa, West Anatolia (21. 9. 1988).

A. Upper Coal Bed ($KP_{1,2}$); Late Miocene (Tortonian): Denis Formation, Yatağan Member. Not worked in the mine.

B. Middle Coal Bed (KM_3); Middle Miocene (Serravallian):Soma Formation, Upper Sekköy Member. Worked at Merkez Munja and Kisrakdere W. mining quarters.

C. Lower Coal Bed ($KM_{1,2}$); Early Miocene (Late Burdigalian): Soma Formation, Upper Turgut Member. Main producer worked at Garb L. I., Karolin and Emas mining quarters.

Tab. 1. Vitrinite reflectances of Soma Dağlari lignites as an indication of coal rank and burial depth.

Horizon	% Rmax (oil)		carbon (%)	$\delta^{13}C_{org}$ (‰ PDB)	
	u.: 0.40		28.9	-25.74	
$KP_{1,2}$	m.: 0.33	M = 0.36	22.0	-26.00	M = -25.54
	l.: 0.36		–	-24.89	
KM_3	0.40		66.3	-24.99	
	u.: 0.42		–	-25.14	
$KM_{1,2}$	m.: 0.45	M = 0.45	–	-24.95	M = -25.43
	l.: 0.48		14.9	-26.19	

From these data the paleogeothermal gradient was calculated to show an increase of 0.03 % Rmax for each 100 m of overburden. Therefore, it may be concluded, that after deposition the Upper Coal Bed ($KP_{1,2}$) subsided in the sedimentary basin to a depth of almost 1000 m.

There is not much difference between the coals, stratigraphically separated as they are, when only the respective $^{13}C_{org}$ values are compared with eachother. The relative enrichment of "light" carbon to an average of -25.73 was obviously effected by the accumulation of prevailing remains of C-3 plants within the organic deposits. Although varying to some degree the values are not related to diagenetic alterations of the lignites but more likely to certain changes in the paleoenvironments, i. e. composition of plaeofloras. It may be noted that the $^{13}C_{org}$ values obtained from the coals of Soma Dağlari match well those of other Tertiary lignites or carbonaceous shales (Takahashi & Jux 1989)

Assumed stratigraphic ages

It was never called in question that the limnic sediments piled up in Soma Dağlari were Neogene in age. Nevertheless, the problem remained to correlate the established formations, members and units not only with sections of adjacent sedimentary basins but also with the current geological time scale. Nebert (1966, 1978) considered the erosional surface above the Middle Coal Bed (=KM_3) to be an unconformity of more than just local importance (Fig. 3). Therefore, he referred the sedimentary cycle starting above this level to Lower Pliocene. This indeed included the Upper Coal Bed (=$KP_{1,2}$). He was well aware of the fact that Soma Formation below could only display part of the Miocene, thus, correlating both Sandstone and Marly Limestone Units (=Sekköy Member) with the Tortonian of Late Miocene (Ketin 1983). Regarding the position of the Miocene/Pliocene boundary Akgün et al. (1986) agreed with Nebert's opinion. Notwithstanding, without giving definite palynologic or other indication as a reason for this arrangement, Sekköy Member together with the Lower Coal Bed was placed by these authors into Middle Miocene (Early Serravallian).

The conclusions drawn by Brinkmann et al. (1971) on the stratigraphic ages of the various basin fills in Soma Dağlari are quite different from the above mentioned ones. First of all, the upper reaches of Miocene deposits were believed to be bound by the Upper Coal Bed (=$KP_{1,2}$); hence, it was inferred that Sand and Clay Unit is Sarmatian (=Messinian) in age, whereas Sekköy Member remained Tortonian.

These correlation were substantiated mainly by fossil ostracods derived from the lacustrine marlstones and spore assembages from the lignites (Lüttig and Benda in Brinkmann et al. 1971).

According to the radiometric date gained from a tuffite on top of $KM_{1,2}$ (Fig. 3) Turgut Member of Soma Formation can not but range in Late Burdigalian instead of Serravallian. Sekköy Member, on the other hand, may at first look date from Serravallian to Tortonian, for this agrees with the conclusions drawn from ostracods, sporomorphs and time equivalent vertebrate remains (Becker-Platen, Benda & Steffens 1977, Sickenberg & Tobien 1971, Akgün et al. 1986).

Unfortunately, there are no more radiometric dates available which directly refer to the Neogene deposits of Soma Dağlari. In spite of that, certain conclusions can be drawn from age determinations of pyroclastic layers (biotites from tuffites) intercalating Miocene sediments in Mugla Basin, which is situated approx. 230 km to the south of Soma city near the Gulf of Gökova. The results obtained there indicate Late Serravallian (11.1 ± 0.2 Ma;13.2 ± 0.35 Ma) for the upper part of Sekköy Member and Early Tortonian for the transitional zone to Yatağan Member above (Becker-Platen, Benda & Steffens 1977).

Certainly, these ages earn special interest because they are associated with the sites of fossil vertbrates at Yeni Eskihisar, which accordingly were considered to belong to Middle Miocene. This also holds for the Yeni Eskihisar pollen assembalge (Benda 1971). Yeni Eskihisar fauna gives a satisfactory account of former lacustrine environments, consisting to a large deal of relevant micromammalians together with turtles and crocodiles. Not until Pliocene the decisive faunal changes were visualized by a diversity of macromammalians which obviously immigrated from both Africa and Asia (Sickenberg & Tobien 1971, Sickenberg 1975).

In consideration of the composition of the Neogene rock sequence in Soma Dağlari the hiatus in the record of sedimentation which is clearly marked by the erosional surface above the Middle Coal Bed may very well hint at environmental disarrangements connected with a prelude of the so-called Messinian Crisis.

Supposing in to be true, the separation between Soma and Denis Formations does not at all correspond with the stratigraphic boundary between Miocen and Pliocene as proposed by Nebert (1960, 1978) and accepted as such by Akgün et al. (1986). In spite of this, the hiatus at the base of Denis Formation appears to correspond quite well the results of various investigations on the structural and regional evolution of western Anatolia.

Relying on the radiometric data published by Ecker-Platen et al. (1977) the Neogene section of Soma Dağlari most likely refers to the following Miocene ages.

Late Miocene (Tortonian) with Yatağan Member of Denis Formation (Upper Coal Bed included)
Middle Miocene (Serravallian-Langhian) with Sekköy Member of upper Soma Formation (Middle Coal Bed included)
Early Miocene (Late Burdigalian) with Turgut Member of lower Soma Formation (Lower Coal Bed included)

Palynomorphs of Miocene lignites in the Soma Basin

Pteridophytic spores

Trilete spores:
(1) *Cicatricosisporites* sp. (pl. 1, figs. 6a, b)
(2) *Monoleiotriletes gracilis* Krutzsch (pl. 1, figs. 2–4)
(3) *Monoleiotriletes* sp. (pl. 1, figs. 1)
(4) *Punctatisporites* sp. (pl. 1, figs. 5)
(5) *Verrucinfulatisporites* cf. *grandis* Nagy (pl. 1, figs. 7a, b)
Monolete spores:
(6) *Laevigatosporites aegyptiacus* Takahashi & Jux (pl. 3, fig. 1)

(7) *Laevigatosporites dehiscens* Takahashi (pl. 1, figs. 8–11; pl. 2, figs. 1–7)
(8) *Laevigatosporites ovoideus* Takahashi (pl. 2, figs. 9–13)
(9) *Laevigatosporites turcicus* n. sp. (pl. 3, figs. 2–7)
(10) *Laevigatosporites undulatus* Takahashi & Jux (pl. 2, fig. 8)

Gymnospermous pollen

Bisaccate pollen:

(11) *Abiespollenites absolutus* Thiergart (pl. 9, fig. 6)
(12) *Abiespollenites* cf. *absolutus* Thiergart (pl. 8, figs. 1–4; pl. 9, figs. 3)
(13) *Abiespollenites microsaccoides* Krutzsch (pl. 9, figs. 1a, b)
(14) ? *Abiespollenites minor* (Chlonova) Krutzsch (pl. 9, fig. 5)
(15) *Cedripites anatolicus* n. sp. (pl. 6, figs. 10, 11)
(16) *Cedripites miocaenicus* Krutzsch (pl. 11, fig. 3)
(17) *Cedripites pseudodeodaraeformis* n. sp. (pl. 10, figs. 3, 4)
(18) *Cedripites szaszvarensis* Nagy (pl. 9, fig. 2)
(19) ? *Cedripites* sp. (pl. 9, fig. 7)
(20) *Piceapollis anatoliensis* n. sp. (pl. 10, figs. 8, 9)
(21) *Piceapollis minor* n. sp. (pl. 11, figs. 2, 4, 5)
(22) *Piceapollis neogenicus* Nagy n. comb. (pl. 9, fig. 4)
(23) *Piceapollis planoides* Krutzsch (pl. 6, fig. 13)
(24) *Piceapollis praemarianus* Krutzsch (pl. 11, fig. 9)
(25) *Piceapollis* cf. *praemarianus* Krutzsch (pl. 8, fig. 9)
(26) *Piceapollis* cf. *sacculiferoides* Krutzsch (pl. 8, figs. 5, 7)
(27) *Piceapollis tobolicus* (Panova) Krutzsch (pl. 7, fig. 8)
(28) *Piceapollis* cf. *tobolicus* (Panova) Krutzsch (pl. 7, figs. 1–3)
(29) *Piceapollis* sp. (pl. 11, figs. 6, 8)
(30) *Pityosporites aralicus* (Bolkhovitina) Krutzsch (pl. 11, fig. 1)
(31) *Pityosporites baileyanus* (Traverse) n. comb. (pl. 10, fig. 5)
(32) *Pityosporites labdacus* (Potonié) Thomson & Pflug *labdacus* (pl. 8, fig. 8)
(33) *Pityosporites labdacus* (Potonié) Thomson & Pflug *maximus* (Potonié) n. comb. (pl. 6, fig. 12)
(34) *Pityosporites macroinsignis* Krutzsch (pl. 10, figs. 6, 7)
(35) *Pityosporites miocaenicus* Nagy n. comb. (pl. 10, figs. 1, 2)
(36) *Pityosporites* cf. *pristinipollinius* (Traverse) Krutzsch (pl. 11, fig. 7)
(37) *Podocarpidites andiniformis* (Zaklinskaja) Takahashi (pl. 7, figs, 6, 7)
(38) *Podocarpidites nageiaformis* (Zaklinskaja) Krutzsch (pl. 7, fig. 5)

(39) *Podocarpidites podocarpoides* (Thiergart) Krutzsch (pl. 6, fig. 9)
(40) *Podocarpidites verrucorpus* Wu (pl. 7, fig. 4)
(41) ? *Podocarpidites* sp. (pl. 8, fig. 6)

Inaperturate pollen:
(42) *Cupressacites* cf. *cuspidataeformis* (Zaklinskaja) Krutzsch (pl. 5, figs. 7–10)
(43) *Cupressacites insulipapillatus* (Trevisan) Krutzsch (pl. 5, figs. 11–15)
(44) *Inaperturopollenites dubius* (Potonié & Venitz) Thomson & Pflug (pl. 4, figs. 1, 2)
(45) *Inaperturopollenites leavigatus* Takahashi (pl. 4, figs. 3–6)
(46) *Inaperturopollenites parvus* Takahashi (pl. 4, figs. 7, 8)
(47) *Psophosphaera aggereloides* (Maljavkina) Chlonova (pl. 4, figs. 9–11)
(48) *Psophosphaera pseudotsugoides* Krutzsch (pl. 4, fig. 12)
(49) *Sequoiapollenites gracilis* Krutzsch (pl. 4, figs. 13–15; pl. 5, fig. 3)
(50) *Sequoiapollenites largus* (Kremp) Manum (pl. 5, figs. 1a –b, 2)
(51) *Sequoiapollenites* cf. *pilaeligulus* Krutzsch (pl. 5, fig. 6)
(52) *Sequoiapollenites polyformosus* Thiergart (pl. 5, figs. 4, 5)
(53) *Sequoiapollenites* sp. (pl. 4, fig. 16)
(54) *Zonalapollenites maximus* (Raatz) Krutzsch (pl. 6, fig. 8)

Monosulcate pollen:
(55) *Cycadopites* sp. (pl. 11, fig. 10)

Polyplicate pollen:
(56) *Ephedripites* (*Ephedripites*) *anatolicus* n. sp. (pl. 15, figs. 14–16)
(57) *Ephedripites* (*Ephedripites*) *hungaricus* Nagy (pl. 15, figs. 12, 13)
(58) *Ephedripites* (*Ephedripites*) *minor* n. sp. (pl. 15, figs. 17–19)

Angiospermous pollen

Inaperturate pollen:
(59) *Monopunctites* sp. (pl. 6, fig. 1)
(60) *Potamogetonacidites difficilis* Takahashi (pl. 6, figs. 4–7)
(61) *Smilacipites* sp. (pl. 6, figs. 2a –b)
(62) ? *Smilacipites* sp. (pl. 6, fig. 3)

Monocolpate (monosulcate) pollen:
(63) *Arecipites brandenburgensis* Krutzsch (pl. 11, figs. 18, 19)
(64) *Arecipites pflugii* (Takahashi) Krutzsch (pl. 11, fig. 17)
(65) *Arecipites* sp. (pl. 11, fig. 20)
(66) *Monocolpopollenites intrabaculatus* Takahashi (pl. 11, fig. 12)
(67) *Monocolpopollenites kyushuensis* Takahashi (pl. 11, figs. 11, 13, 14)

(68) *Monocolpopollenites tranquillus* (Potonié) Thomson & Pflug (pl. 11, figs. 15, 16)
(69) *Monosulcites* sp. (pl. 11, fig. 21)

Monoporate pollen:
(70) *Graminidites laevigatus* Krutzsch (pl. 19, figs. 1–3)
(71) *Graminidites* cf. *laevigatus* Krutzsch (pl. 18, fig. 18)
(72) *Graminidites subtiliglobosus* (Trevisan) Krutzsch (pl. 18, figs. 15–17)
(73) *Graminidites* sp. (pl. 18, fig. 19)

Polycolpate pollen:
(74) *Ranunculacidites* sp. (pl. 15, figs. 11a–b)
(75) *Tetracolpites* sp. (pl. 15, fig. 6)

Polyporate pollen:
(76) *Carpinuspollis carpinoides* (Pflug) Takahashi (pl. 22, Figs. 10, 11)
(77) *Chenpodipollis multiplex* (Weyland & Pflug) Krutzsch (pl. 22, figs. 16, 17)
(78) *Polyatriopollenites stellatus* (Potonié) Pflug (pl. 22, figs. 12–15)
(79) *Polyvestibulopollenites verus* (Potonié) Thomson & Pflug (pl. 22, figs. 7–9)
(80) *Ulmipollenites undulosus* Wolff (pl. 21, fig. 15; pl. 22, fig. 4)
(81) *Zelkovaepollenites potoniei* Nagy (pl. 21, fig. 16; pl. 22, figs. 1–3, 5–6)

Tricolpate pollen:
(82) *Cupuliferoidaepollenites facetus* (Takahashi) Takahashi (pl. 13, fig. 11, 12)
(83) *Cupuliferoidaepollenites fallax* (Potonié) Potonié (pl. 13, figs. 7–10)
(84) *Cupuliferoidaepollenites longus* n. sp. (pl. 13, figs. 14, 15)
(85) *Cupuliferoidaepollenites vulgaris* (Takahashi) Takahashi (pl. 13, figs. 16–21; pl. 14, figs. 1–7)
(86) *Cupuliferoidaepollenites weylandii* (Takahashi) Takahashi (pl. 13, fig. 13)
(87) *Quercoidites densus* (Pflug) Song & Zheng (pl. 12, figs. 7–11)
(88) *Quercoidites henrici* (Potonié) Potonié (pl. 12, figs, 16–24)
(89) *Quercoidites microdensus* Takahashi & Jux (pl. 12, figs. 12–15)
(90) *Quercoidites microhenrici* (Potonié) Potonié (pl. 13, figs. 1–6, 37–39)
(91) *Quercoidites* cf. *punctatus* Takahashi & Jux (pl. 12, fig. 25)
(92) *Quercoidites somaensis* n. sp. (pl. 12, figs. 1–6)
(93) *Retitrescolpites globosus* n. sp. (pl. 14, figs. 24 a –b; pl. 15, figs. 7–10)

(94) *Retitrescolpites* sp. a (pl. 14, fig. 20)
(95) *Retitrescolpites* sp. b (pl. 14, fig. 23)
(96) *Striatopollis circularis* n. sp. (pl. 14, fig. 25; pl. 15, figs. 1–3)
(97) *Striatopollis* sp. (pl. 15, fig. 4, 5)
(98) *Tricolpites* cf. *minutireticulosus* Takahashi (pl. 14, fig. 17)
(99) *Tricolpites retiformis* (Pflug & Thomson) Takahashi & Jux (pl. 14, fig. 18)
(100) *Tricolpites rudis* (Takahashi) Takahashi & Sugiyama (pl. 14, figs. 15 a–b)
(101) *Tricolpites tecturatus* n. sp. (pl. 14, figs. 16 a–b, 19)
(102) *Tricolpites* sp. a (pl. 14, fig. 21)
(103) *Tricolpites* sp. b (pl. 14, fig. 22)
(104) *Tricolpopollenites anatolicus* n. sp. (pl. 13, figs. 23–27)
(105) *Tricolpopollenites asper* Pflug & Thomson (pl. 14, figs. 8–13)
(106) *Tricolpopollenites chagrenatus* Takahashi & Jux (pl. 13, figs. 28–36)
(107) *Tricolpopollenites pseudoasper* Takahashi & Jux (pl. 13, figs. 40–43)
(108) *Tricolpopollenites robusteus* Song, Li & Zhong n. comb. (pl. 14, fig. 14)
(109) *Tricolpopollenites* sp. a (pl. 13, figs. 22, 44)
(110) *Tricolpopollenites* sp. b (pl. 21, fig. 17)

Tricolporate pollen:

(111) *Compositoipollenites denizliensis* Nakoman n. comb. (pl. 18, figs. 14 a–b)
(112) *Cupliferoipollenites fusus* (Potonié) Takahashi & Jux (pl. 17, figs. 7, 8)
(113) *Cupliferoipollenites pusillus* (Potonié) Potonié (pl. 16, figs. 17–22)
(114) *Cupliferoipollenites* cf. *pusillus* (Potonié) Potonié (pl. 16, fig. 24)
(115) *Cupliferoipollenites* sp. (pl. 17, fig. 4)
(116) *Cyrillaceaepollenites megaexactus* (Potonié) Potonié (pl. 17, fig. 2)
(117) *Ilexpollenites margaritatus* (Potonié) Raatz ex Potonié (pl. 18, figs. 11–13)
(118) *Ilexpollenites tertiarius* (Takahashi) Takahashi (pl. 18, figs. 5–10)
(119) *Intrabaculitricolporites consularis* (Takahashi) Takahashi & Jux *consularis* (pl. 16, figs. 1–4; 12–16)
(120) *Intrabaculitricolporites* cf. *consularis* (Takahashi) Takahashi & Jux *consularis* (pl. 16, fig. 23)
(121) *Intrabaculitricolporites consularis* (Takahashi) Takahashi & Jux *globularis* (Takahashi) Takahashi & Jux (pl. 16, figs. 5, 8)
(122) *Intrabaculitricolporites ellipsoideus* Takahashi & Jux n. comb. (pl. 17,

fig. 3)
(123) *Intrabaculitricolporites* sp. a (pl. 17, figs. 1)
(124) *Intrabaculitricolporites* sp. b (pl. 17, figs. 5, 6, 9)
(125) *Nyssapollenites kruschi* (Potonié) Nagy (pl. 16, figs. 6, 7, 9–11)
(126) *Nyssapollenites kruschi* (Potonié) Nagy asp. *pseudolaesus* (Potonié) n. comb. (pl. 16, figs. 25a–b)
(127) *Rhoipites* cf. *bradleyi* Wodehouse (pl. 18, fig. 4)
(128) *Rhoipites finitus* (Guzmán) Takahashi & Jux (pl. 17, fig. 24)
(129) *Rhoipites minus* Takahashi & Jux (pl. 17, figs. 21, 22)
(130) *Rhoipites mirus* Takahashi & Jux (pl. 17, fig. 23)
(131) *Rhoipites retiformis* Rocknall & Mildenhall (pl. 18, fig. 3)
(132) *Rhoipites rotundus* Takahashi & Jux (pl. 18, fig. 2)
(133) *Rhoipites* sp. a (pl. 17, fig. 25)
(134) *Rhoipites* sp. b (pl. 18, fig. 1)
(135) *Striatocolporites ovuliformis* Takahashi & Jux (pl. 17, figs. 20a–b)
(136) *Striatocolporites* sp. a (pl. 17, fig. 18)
(137) *Striatocolporites* sp. b (pl. 17, fig. 19)
(138) *Tricolporopollenites pseudochagrenatus* Takahashi & Jux (pl. 17, fig. 13)
(139) *Tricolporopollenites turcianus* n. sp. (pl. 16, figs. 26–29)
(140) *Tricolporopollenites* cf. *turcianus* n. sp. (pl. 17, fig. 11)
(141) *Tricolporopollenites* sp. a (pl. 17, fig. 10)
(142) *Tricolporopollenites* sp. b (pl. 17, fig. 12)
(143) *Tricolporopollenites* sp. c (pl. 17, fig. 14)
(144) *Tricolporopollenites* sp. d (pl. 17, fig. 15)
(145) *Tricolporopollenites* sp. e (pl. 17, fig. 16)
(146) *Tricolporopollenites* sp. f (pl. 17, fig. 17)

Triporate pollen:
(147) *Betulaepollenites* sp. (pl. 21, figs. 1, 2)
(148) *Caryapollenites simplex* (Potonié) Raatz *simplex* (pl. 21, figs. 12–14)
(149) *Engelhardtioidites microcoryphaeus* (Potonié) Potonié, Thomson & Thiergart ex Potonié (pl. 20, figs. 8, 9)
(150) *Engelhardtioipollenites punctatus* (Potonié) Potonié ex Potonié (pl. 19, fig. 17; pl. 20, figs. 1–6)
(151) *Momipites somaensis* n. sp. (pl. 20, figs. 14, 15, 20)
(152) *Momipites* sp. (pl. 20, fig. 21)
(153) *Subtriporopollenites kyushuensis* Takahashi (pl. 20, figs. 22, 23; pl. 21, figs. 4–7)

(154) *Tiliaepollenites instructus* Potonié ex Potonié & Venitz (pl. 21, figs. 8–11)
(155) *Triatriopollenites pseudorurensis* Pflug (pl. 19, figs. 8, 9)
(156) *Triatriopollenites rurensis* Pflug & Thomson (pl. 19, figs. 4–7)
(157) *Triatriopollenites* sp. (pl. 19, fig. 16)
(158) *Triporopollenites shimensis* Takahashi (pl. 20, figs. 11, 12)
(159) *Triporopollenites moderatus* n. sp. (pl. 20, figs. 16–19)
(160) *Triporopollenites subfragilis* Takahashi & Jux (pl. 19, figs. 10–15; pl. 20, figs. 7, 10)
(161) *Triporopollenites* sp (pl. 20, fig. 13)
(162) *Trivestibulopollenites betuloides* Pflug (pl. 21, fig. 3)

Incertae sedis
(163) *Monogemmites pseudosetarius* (Weyland & Pflug) Krutzsch (pl. 3, figs. 8–13)
(164) *Ovoidites lanceolatus* n. sp. (pl. 23, figs. 1, 2)
(165) *Ovoidites pseudoligneolus* Krutzsch (pl. 23, figs. 6–8)
(166) *Ovoidites raatzi* Nakoman (pl. 23, fig. 5)
(167) *Schizosporis cooksoni* Pocock (pl. 23, fig. 3)
(168) *Schizosporis ellipsoideus* n. sp. (pl. 23, figs. 9, 10)
(169) *Schizosporis* cf. *parvus* Cookson & Dettmann (pl. 23, fig. 4)

Systematic description

The genera and species described here are arranged alphabetically under the broad heading of pteridophytic spores (trilete and monolete spores), gymnospermous pollen (bisaccate, inaperturate, monosulcate, and polyplicate pollen), angiospermous pollen (inaperturate, monoporate, polycolpate, polyporate, tricolpate, tricolporate, and triporate pollen), and incertae sedis.

Pteridophytic spores
Trilete spores:
Genus: *Cicatricosisporites* Potonié & Gelletich 1933.
Type species: *Cicatricosisporites dorogensis* Potonié & Gelletich 1933.

(1) *Cicatricosisporites* sp.
Pl. 1, figs. 6a, b.

Descripetion: Trilete microspore. Amb rounded-triangular with convex sides and rounded corners in polar view. Trilete mark with 4−5 μm wide lips slender, straight, extending to the equatorial corners. Proximal face pyramidal, smooth; distal face convex. Exine thin; sculpture canaliculate; proximal sculptural pattern consists of one or two ribs with 8−10 μm width and distal one rather roughly rugulate than canaliculate. The ribs run parallel to the sides.
Dimensions: 61.5 X 39 μm in diameter.
Occurrence: $KM_{1,2}$ lower (GN 5401).
Botanical affinity: Schizaeaceae.

Genus: *Monoleiotriletes* Krutzsch 1959.
Type species: *Monoleiotriletes angustus* Krutzsch 1959.

(2) *Monoleiotriletes gracilis* Krutzsch
Pl. 1, figs. 2−4.

Description: See Krutzsch (1959).
Dimensions: 30−36 μm in diameter; exine thin.
Occurrence: $KM_{1,2}$ middle (GN 5412).
Botanical affinity: Unknown.

(3) *Monoleiotriletes* sp.
Pl. 1, fig. 1.

Description: Trilete spore. Outline subcircular with convex sides and rounded corner in polar view. Trilete laesurae slender, straight, not reaching the periphery. Exine thin, one-layered, and chagrenate.
Dimensions: 41 X 29 μm in diameter.
Occurrence: $KM_{1,2}$ lower (GN 5401).
Botanical affinity: Unknown.

Genus: *Punctatisporites*: Ibrahim 1933.
Type species: *Punctatisporites punctatus*: (Ibrahim 1932) Ibrahim 1933.

(4) *Punctatisporites* sp.
Pl. 1, fig. 5.

Description: Trilete spore. Amb subcircular in polar view. Trilete laesurae

straight, reaching the equatorial margin. Exine finely punctate or granulate; sculptural elements arrange more or less striately, less than 1 μm high.
Dimensions: 39 X 35 μm in diameter.
Occurrence: KM $_{1,2}$ lower (GN 5401).
Botanical affinity: Unknown.

Genus: *Verrucingulatisporites* Kedves 1961.
Type species: *Verrucingulatisporites verrucatus* Kedves 1961.

(5) *Verrucingulatisporites* cf. *grandis* Nagy
Pl. 1, figs. 7a, b.

1985 *Verrucingulatisporites grandis* Nagy, Geol. Hungarica, Ser. Palaeont., Fas. 47, p. 106. pl. 36, figs. 15–18.

Description: See Nagy (1985).
Dimensions: 53 μm in outside diameter; 42 μm in inside diameter; cingulum 5–6.5 μm thick; verrucate-corrugate.
Occurrence: KM $_{1,2}$ upper (GN 5421).
Remarks: The present specimen is very closely similar to *Verrucingulatisporites grandis* of Miocene deposits (Eggenburgian) in Hungary in spite of its larger size.
Botanical affinity: Pteridaceae.

Monolete spores:
Genus: *Laevigatosporites* Ibrahim 1933.
Type species: *Laevigatosporites vulgaris* (Ibrahim 1932) Ibrahim 1933.

(6) *Laevigatosporites aegyptiacus* Takahashi & Jux
Pl. 3, fig. 1.

1989 *Laevigatosporites aegyptiacus* Takahashi & Jux, Bull. Fac. Liberal Arts, Nagasaki Univ., Nat. Sci. vol. 29, no. 2, p. 380, pl. 4, figs. 3–12.

Description: See Takahashi & Jux (1989).
Dimensions: 52 μm in length; 42 μm in width; exine thin; dehiscens 25 μm long; width/length ratio:0.8.
Occurrence: KM $_{1,2}$ upper (GN 5421); KP $_{1,2}$ lower (GN 5466).

Botanical affinity: Polypodiaceae.

(7) *Laevigatosporites dehiscens* Takahashi
Pl. 1, figs. 8–11; pl. 2, figs. 1–7.

1961 *Laevigatosporites dehiscens* Takahashi, Mem. Fac. Sic., Kyushu Univ., Ser. D, Geol., vol. 11, no. 3, p. 290, pl. 16, figs. 4–8.

Description: See Takahashi (1961).
Dimensions: 29–51 μm in length;18–36 μm in width; exine thin; width/length ratio: 0.545–0.576.
Occurrence: $KM_{1,2}$ upper (GNd5421, GN 5423), middle (GN 5411,GN 5412), and lower (GN 5401, GN 5402); $KP_{1,2}$ lower (GN 5466) and middle (GN 5476).
Botanical affinity: Poypodiaceae.

(8) *Laevigatosporites ovoideus* Takahashi
Pl. 2, figs. 9–13.

1961 *Laevigatosporites ovoideus* Takahashi, Mem. Fac. Sci., Kyushu Univ., Ser. D, Geol., vol. 11, no. 3, pp. 288–289, pl. 16, figs. 9–14.

Description: See Takahashi (1961).
Dimensions: 40–46 μm in length; 34–38 μm in width; exine thin; width/length ratio: 0.809–0.95.
Occurrence: $KM_{1,2}$ middle (GN 5412) and upper (GN 5421, GN 5422, GN 5423); KM_3 Kisrakdere W. (GN 5451, GN 5452); $KP_{1,2}$ lower (GN 5466), middle (GN 5476), and upper (GN 5486).
Botanical affinity: Polypodiaceae.

(9) *Laevigatosporites turcicus* n. sp.
Pl. 3, figs. 2–7.

Description: Monolete spore with an elliptical or somewhat bean-shaped contour in lateral view. Dehiscence side convex, concave or straight; furrow convex, concave or straigh, moderately long (27–35 μm), slender and conspicuous. Exospore thin, laevigate, with secondary folds due to fossilization.
Dimensions: 47–54 μm in length.
23.5–35 μm in width.

Width/length ratio: 0.479–0.648.

Occurrence: KM 1, 2 middle (GN 5412, GN 5413) and upper (GN 5422).

Holotype: Pl. 3, fig. 5; 53 X 32 μm in size; exine thin, leavigate; dehiscence furrow straight, 35 μm long; width/length ratio: 0.603.

Name derivation :*turcicus* (lat.)=Turkish.

Comparison: This new species is similar to *Leavigatosporites aegyptiacus* Takahashi & Jux (1989) from Late Eocene to Early Oligocene lignites of Fayum Oasis (Egypt) and *Leavigatosporites javanicus* Takahashi (1982) from the Eocene Nanggulan Formation of central Java, but differs from *L. aegyptiacus* in having narrower form and longer dehiscence furrow and from *L. javanicus* in possessing narrower form and thinner exine.

Botanical affinity: Polypodiaceae.

(10) *Laevigatosporites undulatus* Takahashi & Jux
Pl. 2, fig. 8.

1989 *Laevigatosporites undulatus* Takahashi & Jux, Bull. Fac. Liberal Arts, Nagasaki Univ., Nat. Sci., vol. 29, no. 2, pp. 380–381, pl. 5, figs. 3–12; pl. 6, fig. 3 (cf.).

Description: See Takahashi & Jux (1989).

Dimensions: 40 X 32 μm in size; exine thin, dehiscence undulate, 17 μm long; width/length ratio: 0.8.

Occurrence: KP 1, 2 lower (GN 5466).

Botanical affinity: Peranemataceae, *Acrophorus*.

Gymnospermous pollen

Bisaccate pollen:

Genus: *Abiespollenites* Thiergart 1937.

Type species: *Abiespollenites absolutus* Thiergart 1937.

(11) *Abiespollenites absolutus* Thiergart
Pl. 9, fig. 6.

1937 *Abies-pollenites absolutus* Thiergart, Jb. Preuß. Geol., L.–A. F., 58, p. 306, pl. 24, fig. 6.

1971 *Abiespollenites absolutus* Thiergart, Krutzsch, Atlas, Lfg. VI, p. 86, pl. 15, figs. 1–9.

Description: See Thiergart (1937) and Krutzsch (1971).
Dimensions: Overall width of grain 91 μm; width of central body 50 μm; length of central body 69 μm; width of bladder 41 μm; length of bladder 69 μm; proximal cap 2 μm thick.
Occurrence: KM 1, 2 upper (GN 5421).
Botanical affinity: Pinaceae, *Abies*.

(12) *Abiespollenites* cf. *absolutus* Thiergart
Pl. 8, figs. 1–4; pl. 9, fig. 3.

Dimensions: Overall width of grain 66–93 μm; overall length of grains 76–87 μm; overall height of grains 70–72 μm; width of central body 65 μm; length of central body 72–87 μm; height of central body 42–53 μm; width of sacci 29–37 μm; length of sacci 65–72 μm; width of sacci in lateral view 40–43 μm; proximal cap 2.2–4 μm thick.
Occurrence: KM 1, 2 lower (GN 5401), middle (GN 5411); KP 1, 2 middle (GN 5476).

(13) *Abiespollenites microsaccoides* Krutzsch
Pl. 19, figs. 1a, b.

1971 *Abiespollenites microsaccoides* Krutzsch, Atlas, Lfg. VI, p. 94, pl. 19, figs. 1–6.

Description: See Krutzsch (1971).
Dimensions: Overall height of grain 72 μm; length of central body 86 μm; height of central body 27 μm; length of bladders 70–74 μm.
Occurrence: KM 1, 2 lower (GN 5401).
Botanical affinity: Pinaceae, *Abies*.

(14) ? *Abiespollenites minor* (Chlonova) Krutzsch
Pl. 9, fig. 5.

1960 *Abies minor* Chlonova, Trudy Inst. Geol. Geophys., Acad. Sci., USSR, Siberian Br., vol. 3, pp. 52–53, pl. 7, fig. 11.
1971 *Abiespollenites* (resp. *Abies*) *minor* (Chlonova, 1960) Krutzsch, Atlas, Lfg. p. 20.

Description: See Chlonova (1960).
Dimensions: Overall width of grain 100 μm; overall length of grain 72 μm;

width of central body 68 μm; length of central body 62 μm; width of bladders 35 μm; length of bladders 67 μm; proximal cap 6 μm thick.
Occurrence: $KM_{1,2}$ upper (GN 5422).
Remarks : Only one specimen was observed. Whether this belongs to the genus *Abiespollenites* or not, is questionable.
Botanical affinity: Pinaceae, ? *Abies*.

Genus: *Cedripites* Wodehouse 1933.
Type species: *Cedripites eocenicus* Wodehouse 1933.

(15) *Cedripites anatolicus* n. sp.
Pl. 6, figs. 10, 11.

Description: Bisaccate, cedroid pollen grains with broad-elliptical or oval outline in polar view. Central body elliptical or subprolate in polar view, finely punctate; proximal cap 2.5 − 3 μm thick, intrarugulate. Sacci small, finely reticulate, attached to the distal side of central body. Distal furrow between sacci relatively wide, smooth, parallel or convex.
Dimensions: Overall width of grains 61−67 μm.
Overall length of grains 65−69 μm.
Width of central body 59 μm.
Length of central body 67−69 μm.
Width of sacci 20−28 μm.
Length of sacci 59−62 μm.
Occurrence: $KM_{1,2}$ lower (GN 5401) and upper (GN 5421).
Holotype: Pl. 6, fig. 11; overall width of grain 61 μm; width of central body 59 μm; length of central body 69 μm; width of sacci 20−24 μm; length of sacci 62 μm; proximal cap 2.5 μm thick; $KM_{1,2}$ lower (GN 5401).
Name derivation: From Anatolia district of Turkey.
Comaprison: *Cedripites anatolicus* is similar to *Cedripites lusaticus* Krutzsch from the Neogene zone IX of Germany and *Cedripites* sp. A (aff. *balticus* Zauer 1960) from the Early Oligocene or Early Miocene of Germany, but differs from *C. lusaticus* and *C.* sp. A in larger form.
Botanical affinity: Pinaceae, *Cedrus*.

(16) *Cedripites miocaenicus* Krutzsch
Pl. 11, fig. 3.

1971 *Cedripites miocaenicus* Krutzsch, Atlas, Lfg. VI, p. 120, pl. 29, figs. 1–8; text-fig. 8 (38).

Description: See Krutzsch (1971).
Dimensions: Width of central body 57 μm; length of central body 51 μm; width of sacci 30 μm; length of sacci 40 μm; radial structure (or fold) of sacci 11 μm wide.
Occurrence: KM $_{1,2}$ lower (GN 5401).
Botanical affinity: Pinaceae, *Cedrus*.

(17) *Cedripites pseudodeodaraeformis* n. sp.
Pl. 10, figs. 3, 4.

Description: Bisaccate, cedroid pollen grains with spherical outline in polar view. Central body spherical or oval in polar view, finely punctate; proximal cap 2–4 μm thick, intrarugulate. Sacci small, attached to the distal side of central body, finely reticulate; reticulum arranging radially. Distal furrow between sacci relatively wide, finely punctate, slightly concave or convex.
Dimensions: Overall width of grains 73–86 μm; overall length of grains 70 μm; width of central body 66–67 μm; length of central body 65–70 μm; width of bladders 24–47 μm; length of bladders 65–70 μm.
Occurrence: KM $_{1,2}$ lower (GN 5401) and KP $_{1,2}$ lower (GN 5466).
Holotype: Pl. 10, fig. 3; overall width of grain 86 μm; width of central body 66 μm; length of central body 70 μm; width of bladders 28–47 μm; length of bladders 70 μm; proximal cap 4 μm thick; KM $_{1,2}$ lower (GN 5401).
Name derivation: With similarity to *Cedripites* (al. *Cedrus*) *deodaraeformis* Bolkhovitina n. comb.
Comparison: The present specimens are closely similar to *Cedripites* (al. *Cedrus*) *deodaraeformis* Bolkhovitina (1953) n. comb. (=*oedemosaccus deodaraeformis* Bolkhovitina 1953) from Cretaceous deposits of northern shore of the Arai Sea, western Kazakhstan, but differ in being much smaller in size.
Botanical affinity: Pinaceae, *Cedrus*.

(18) *Cedripites szaszvarensis* Nagy
Pl. 9, fig. 2.

1969 *Cedripites szăszvărensis* Nagy, MAFI Evk., vol. 52, Fas. 2, pp. 382–383, pl. 33, fig. 2.

Description: See Nagy (1969).
Dimensions: Width of central body 46 μm; length of central body 56 μm; width of sacci 15−20 μm; length of sacci 42−48 μm.
Occurrence: KM$_{1,2}$ upper (GN 5422).
Botanical affinity: Pinaceae, *Cedrus*.

(19) ? *Cedripites* sp.
Pl. 9, fig. 7.

Description: Pollen grain with slightly developed sacci. Outline subcircular in lateral view (?). Central body covered with thick outer coat (proximal cap, 5−8 μm thick). Distal furrow between sacci (?) very narrow.
Dimensions: Overall width of grain 48 μm; overall height of grain 46 μm.
Occurrence: KM$_{1,2}$ upper (GN 5421).
Remarks: The present specimen is different morphologically from other *Cedripites* species. This is rather similar to *Cedripites oligocaenus* Krutzsch (1971) from the middle and late Oligocene of Germany, but it is doubtful that this belongs to be genus *Cedripites*.
Botanical affinity: Pinaceae (?), *Cedrus* (?).

Genus: *Piceapollis* Krutzsch 1971.
Type species: *Piceapollis praemarianus* Krutzsch 1971.

(20) *Piceapollis anatoliensis* n. sp.
Pl. 10, figs. 8, 9.

Description: Bisaccate, piceoid pollen grains. Outline broad-elliptical or oval in oblique distal view and oblique lateral view. Central body broad-elliptical in oblique distal view and oval in oblique lateral view, finely punctate; cap 2−5 μm thick, intrarugulate. Sacci parvisaccate or aequisaccate, finely reticulate. Distal furrow between sacci finely punctate, very narrow; ventral root of saccus slightly convex.
Dimensions: Overall width of grain 67 μm; overall length of grain 73.4 μm; overall height of grain 75 μm; width of central body 62−65 μm; length of central body 64 μm; height of central body (?) 33 μm; width of sacci 30−35 μm; length of sacci 61−67 μm.
Occurrence: KM$_{1,2}$ upper (GN 5422, GN 5423).
Holotype: Pl. 10, fig. 8; overall width of grain 67 μm; overall length of grain

73.4 μm; width of central body 62 μm; length of central body 64 μm; width of sacci 30 μm; length of sacci 61 μm; proximal cap 2 μm thick; $KM_{1,2}$ upper (GN 5422).

Name derivation: From Anatolia district of Turkey.

Comparison: In general shape and size *Piceapollis anatoliensis* compares somewhat to those of *Piceapollis sacculiferoides* Krutzsch (1971) from the Neogene of Germany, but differs in having comparatively smaller central body and finer reticulum of sacci.

Botanical affinity: Pinaceae, *Picea* .

(21) *Piceapollis minor* n. sp.
Pl. 11, figs. 2, 4, 5.

Description: Bisaccate, piceoid pollen grains. Outline subcircular in polar view. Central body broad-elliptical or oval in polar view, finely punctate; proximal cap ca. 3 μm thick, intrabaculate. Sacci aequisaccate, finely reticulate. Distal furrow between sacci smooth, narrow; ventral root of sacci concave.

Dimensions: Overall width of grains 61−63 μm.
Overall length of grains 51−64 μm.
Width of central body 56−63 μm.
Length of central body 42−62 μm.
Width of bladder 27−47 μm.
Length of bladder 50−59 μm.

Occurrence: $KM_{1,2}$ lower (GN 5401) and upper (GN 5421); KM_3 Merkez Munja (GN 5436).

Holotype: Pl. 11, fig. 5; overall length of grain 51 μm; width of central body 63 μm; length of central body 42 μm; width of bladders 27 μm; length of bladders 50 μm; $KM_{1,2}$ upper (GN 5421).

Name derivation: *minor* (lat.)=lesser in size.

Comparison: The authors cannot find a species comparable with the present specimens. The new species is different from *Piceapollis sacculiferoides* Krutzsch and *Piceapollis anatoliensis* n. sp. in being smaller in size.

Botanical affinity: Pinaceae, *Picea*.

(22) *Piceapollis neogenicus* Nagy n. comb.
Pl. 9, fig. 4.

1969 *Piceapollenites neogenicus* Nagy, MAFI Evk., vol. 52, Fas. 2, p. 379, pl. 32, fig. 1.

Description: See Nagy (1969).
Dimensions: Overall width of grain 106 μm; overall height of grain 68 μm; width of central body 99 μm; height of central body 55 μm; height of bladders 64 μm; width of bladders in lateral view 36 μm; proximal cap 3 μm thick.
Occurrence: KM $_{1,2}$ lower (GN 5401).
Botanical affinity: Pinaceae, *Picea* .

(23) *Piceapollis planoides* Krutzsch
Pl. 6, fig. 13.

1971 *Piceapollis planoides* Krutzsch, Atlas, Lfg. VI, pp. 110–111, pl. 25, figs. 1–4, text-fig. 7 (31).

Description: See Krutzsch (1971).
Dimensions: Width of central body 106 μm; length of central body 74 μm; width of bladders 41 μm; length of bladders 74 μm; proximal cap 8 μm thick.
Occurrence: KM $_{1,2}$ lower (GN 5401).
Botanical affinity: Pinaceae, *Picea* .

(24) *Piceapollis praemarianus* Krutzsch
Pl. 11, fig. 9.

1971 *Piceapollis praemarianus* Krutzsch, Atlas Lfg. VI, p. 106, pl. 23, figs. 1–9, text-fig. 7 (29).

Description: See Krutzsch (1971).
Dimensions: Overall width of grain 83 μm; overall height of grain 52 μm; width of central body 78 μm; height of central body 43 μm; height of bladders 21 μm; width of bladders in lateral view 41 μm; proximal cap 2 μm thick.
Occurrence: KM $_{1,2}$ upper (GN 5422).
Botanical affinity: Pinaceae, *Picea* .

(25) *Piceapollis* cf. *praemarianus* Krutzsch
Pl. 8, fig. 9.

Dimensions: Overall width of grain 80 μm; width of central body 61 μm; length of central body 68 μm; width of bradders 44 μm; length of bladder 67 μm; proximal cap 5 μm.
Occurrence: KM $_{1,2}$ middle (GN 5412).
Botanical affinity: Pinaceae, *Picea* .

(26) *Piceapollis* cf. *sacculiferoides* Krutzsch
Pl. 8, figs. 5, 7.

1971 *Piceapollis sacculiferoides* Krutzsch, Atlas Lfg. VI, p. 108, pl. 24, figs. 1–8; tab. 5 (30).

Description: See Krutzsch (1971).
Dimensions: Overall height of grain 53–55 μm; length of central body 76–80 μm; height of central body 84 μm; length of bladders 74 – 75 μm; height of badders 25–29 μm; proximal cap 2–3 μm thick.
Occurrence: KM $_{1,2}$ upper (GN 5421) and KP $_{1,2}$ middle (GN 5476).
Botanical affinity: Pinaceae, *Picea* .

(27) *Piceapollis tobolicus* (Panova) Krutzsch
Pl. 7, fig. 8.

1966 *Picea tobolica* Panova, Palaeopalynologia, no.1, p. 220; no. 3, pl. 105, fig. 5; pl. 103, 108, XLIX & LII.
1971 *Piceapollis tobolicus* (Panova 1966) Krutzsch, Atlas Lfg. VI, p. 104, pl. 22, figs. 1–6; tab. 5 (28).

Description: See Panova (1966) and Krutzsch (1971).
Dimensions: Overall width of grain 145 μm; overall length of grain 95 μm; width of central body 105 μm; length of central body 89 μm; width of bladders 75 μm; length of bladders 60 μm; proximal cap 2.5–4 μm thick.
Occurrence: KM $_{1,2}$ upper (GN 5422).
Botanical affinity: Pinaceae, *Picea* .

(28) *Piceapollis* cf. *tobolicus* (Panova) Krutzsch
Pl. 7, figs. 1–3.

Dimensions: Overall width of grain 105–114 μm; oberall length of grains 97–

100 μm; overall height of grains 75−90 μm; width of central body 91−114 μm; length of central body 79 μm; width of bladders 45−46 μm; length of bladder 78−85 μm; cap 4 μm thick.
Occurrence: $KM_{1,2}$ middle (GN 5412) and upper (GN 5421, GN 5423).
Botanical affinity: Pinaceae, *Picea* .

(29) *Piceapollis* sp.
Pl. 11, figs. 6, 8.

Description: Bisaccate pollen grains. Outline subcircular in polar view. Sacci small, parvisaccate, reticulate (?). Central body subcircular or oval in polar view, finely punctate or granulate. Distal furrow between sacci very narrow, finely punctate or granulate; ventral root of sacci strongly concave.
Dimensions: Width of central body 67−69 μm.
Length of central body 67−71 μm.
Width of sacci 30−35 μm.
Length of sacci 60−66 μm.
Proximal cap 1.5−3 μm thick.
Occurrence: $KM_{1,2}$ upper (GN 5421) and lower (GN 5401); $KP_{1,2}$ middle (GN 5476) and upper (GN 5486)
Remarks: Four specimens were observed. They belong morphologically to the genus *Piceapollis* , but are not determined these specific epithet.
Botanical affinity: Pinaceae, *Picea* .

Genus: *Pityosporites* Seward 1914.
Type species: *Pityosporites antarcticus* Seward 1914.

(30) *Pityosporites aralicus* (Bolkhovitina) Krutzsch
Pl. 11, fig. 1.

1953 *Pinus aralica* Bolkhovitina (1953) (=*Oedemosaccus aralicus* Bolkhovitina 1953), Trudy Inst. Geol. Sci., Acad. Sci. USSR, 145, Geol. Ser. no. 61, p. 83, pl. 12, figs. 12−13.
1971 *Pityosporites* cf. *aralicus* (Bolch. 1953) Krutzsch, Atlas, Lfg. VI, p. 68, pl. 9, figs. 1−7; tab. 3 (15).

Description: See Bolkhovitina (1953) and Krutzsch (1971).
Dimensions: Overall width of grain 70 μm; overall height of grain 53 μm; width

of central body 55 μm; height of central body 30 μm; height of bladders 35 μm; width of bladder in lateral view 39 μm; proximal cap 1 μm; thick.
Occurrence: KP $_{1,2}$ upper (GN 5486).
Botanical affinity: Pinaceae, *Pinus* .

(31) *Pityosporites baileyanus* Traverse n. comb.
Pl. 10, fig. 5.

1955 *Pinus baileyana* Traverse, Bureau of Mines, Rept. Invest. 5151, pp. 40–41, fig. 8 (11–12).

Description: See Traverse (1955).
Dimensions: Overall width of grain 83 μm.
Width of central body 52 μm.
Length of central body 62 μm.
Width of bladders 40 μm.
Length of bladders 62 μm.
Proximal cap 2 μm thick.
Occurrence: KP $_{1,2}$ upper (GN 5486).
Remarks: The present specimen appears to be closely comparable to those of *Pityosporites* (al. *Pinus*) *baileyanus* (Traverse) n. comb. from upper Oligocene Brandon lignites, Vermont (USA). In spite of Krutzsch's (1971) treatment as a synonym of *Pityosporites alatus*, the authors reserve this species-name, because this one is larger in size than *Pityosporites alatus*.
Botanical affinity: Pinaceae, *Pinus* .

(32) *Pityosporites labdacus* (Potonié) Thomson & Pflug *labdacus*
Pl. 8, fig. 8.

1931 *Pollenites labdacus* R. Potonié, Jb. Preuß. Geol. L.-A. F., 52, p. 5, Abb. 32.
1938 *Pinus-pollenites labdacus* R. Potonié, Thiergart, Jb. Preuß. Geol. L.-A. F., 58, p. 306, pl. 24, fig. 4.
1953 *Pityosporites labdacus* (R. Potonié) Thomson & Pflug, Palaeontographica, B, 94, p. 68, pl. 5, figs. 60, 61 (p. p.).
1971 *Pityosporites labdacus* (R. Potonié) Thomson & Pflug subsp. *labdacus*, Krutzsch, Atlas, Lfg. VI, p. 64, pl. 7, figs. 10–18.

Description: See R. Potonié (1931) and Krutzsch (1971).
Dimensions: Overall width of grain 71 μm; overall length of grain 50 μm; width

of central body 47 μm; length of central body 46 μm; width of bladders 27 μm; length of bladders 50 μm; proximal cap 2 μm thick.

Occurrence: KM$_{1,2}$ upper (GN 5423); KM$_3$ Merkez Munja (GN 5436).

Botanical affinity: Pinaceae, *Pinus* .

(33) *Pityosporites labdacus* (Potonié) Thomson & Pflug *maximus* (Potonié) n. comb.

Pl. 6, fig. 12.

1931 *Pollenites labdacus* R. Potonié, Jb. Preuß. Geol. L.-A. F., 52, p. 5, Abb. 32.

1951 *Abietineae-pollenites labdacus maximus* R. Potonié, Palaeontographica, B, 91, p. 145, pl. 20, fig. 23.

1958 *Pinuspollenites* (al. *Abietineaepollenites*) *labdacus maximus* (Potonié) Potonié, Beih. Geol. Jb., 31, p. 62.

Description: See R. Potonié (1931).

Dimensions: Overall width of grain 85 μm.
Width of central body 56 μm.
Length of central body 68 μm.
Width of bladders 40 μm.
Length of bladders 55 μm.
Proximal cap 0.8 μm thick.

Occurrence: KM$_{1,2}$ lower (GN 5401).

Botanical affinity: Pinaceae, *Pinus* .

(34) *Pityosporites macroinsignis* Krutzsch

Pl. 10, figs. 6, 7.

1971 *Pityosporites macroinsignis* Krutzsch, Atlas, Lfg. VI, p. 62, pl. 6, figs. 5 – 13; tab. 3 (12).

Description: See Krutzsch (1971).

Dimensions: Overall width of grains 80 – 84 μm; overall length of grains 54 – 57 μm; width of central body 55 – 57 μm; length of central body 47 – 55 μm; width of sacci 39 – 43 μm; length of sacci 50 – 57 μm; proximal cap 1.5 – 2 μm thick.

Occurrence: KM$_{1,2}$ lower (GN 5401) and middle (GN 5411); KM$_{1,2}$ upper (GN 5486).

Botanical affinity: Pinaceae, *Pinus* .

(35) *Pityosporites miocaenicus* Nagy n. comb.
Pl. 10, figs. 1, 2.

1985 *Pinuspollenites miocaenicus* Nagy, Geol. Hungarica, Ser. Palaeont., Fas. 47, pp. 130–131, pl. 59, figs. 1–8.

Description: See Nagy (1985).
Dimensions: Overall width of grains 88–90 μm.
Overall height of grains 50–58 μm.
Width of central body 58–63 μm.
Height of central body 35–41 μm.
Height of bladders 29–32 μm.
Width of bladders in lateral view 37–39 μm.
Proximal cap 2 μm thick.
Occurrence: $KM_{1,2}$ lower (GN 5401, GN 5402).
Botanical affinity: Pinaceae, *Pinus*.

(36) *Pityosporites* cf. *pristinipollinius* (Traverse) Krutzsch
Pl. 11, fig. 7.

1955 *Pinus pristinipollinius* Traverse, Bur. Mines, Rept. Invest. 5151, p. 42, fig. 9 (20).
1971 *Pityosporites pristinipollinius* (Traverse) Krutzsch, Atlas, Lfg. VI. p. 72, pl. 11, figs. 1–11.

Description: See Traverse (1955) and Krutzsch (1971).
Dimensions: Overall width of grains 70–102 μm; width of central body 60–75 μm; height of central body 45–52 μm; height of bladders 45–56 μm; width of bladders in lateral view 31–37 μm; proximal cap 2 μm thick.
Occurrence: KM_3 Merkez Munja (GN 5436); $KP_{1,2}$ middle (GN 5476) and upper (GN 5486).
Botanical affinity: Pinaceae, *Pinus* .

Genus: *Podocarpidites* Cookson 1947.
Type species: *Podocarpidites ellipticus* Cookson 1947.

(37) *Podocarpidites andiniformis* (Zaklinskaja) Takahashi
Pl. 7, figs. 6, 7.

1957 *Podocarpus andiniformis* Zaklinskaja, Trudy Geol. Inst., Acad. Sci. USSR, 6, p. 105, pl. 2, figs. 3–7.
1964 *Podocarpidites andiniformis* (Zaklinskaja) Takahashi, Mem. Fac. Sci., Kyushu Univ., Ser. D, Geol., vol. 14, no. 3, p. 227.

Description: See Zaklinskaja (1957).
Dimensions: Overall width of grain 75 μm; overall length of grains 54–57 μm; width of central body 40–41 μm; length of central body 44 μm; width of sacci 35 μm; length of sacci 54–57 μm.
Occurrence: KP $_{1,2}$ middle (GN 5477).
Botanical affinity: Podocarpaceae, *Podocarpus*.

(38) *Podocarpidites nageiaformis* (Zaklinskaja) Krutzsch
Pl. 7, fig. 5.

1957 *Podocarpus nageiaformis* Zaklinskaja, Trudy Geol. Inst., Acad. Sci. USSR, 6, p. 106, pl.2, figs. 8–11.
1971 *Podocarpidites nageiaformis* (Zaklinskaja) Krutzsch, Atlas, Lfg. VI, p. 130, 132, pl. 34, figs. 1–11.

Description: See Zaklinskaja (1957) and Krutzsch (1971).
Dimensions: Overall width of grain 80 μm; overall length of grain 48 μm; width of central body 47 μm; length of central body 42 μm; width of bladders 33 μm; length of bladders 48 μm; proximal cap 3 μm thick.
Occurrence: KP $_{1,2}$ upper (GN 5489).
Botanical affinity: Podocarpaceae, *Podocarpus*.

(39) *Podocarpidites podocarpoides* (Thiergart) Krutzsch
Pl. 6, fig. 9.

1958 *Pityosporites podocarpoides* Thiergart, Fortschr. Geol. Rheinl. u. Westf., 2, p. 449, pl. 1, fig. 15.
1971 *Podocarpidites podocarpoides* (Thiergart) Krutzsch, Atlas, Lfg. VI, p. 130, pl. 33, figs. 1–11.

Description: See Thiergart (1958) and Krutzsch (1971).
Dimensions: Overall width of grains 61–64 μm; overall length of grains 39–62 μm; width of central body 30–32 μm; length of central body 28–47 μm; width of sacci 25–28 μm; length of sacci 39–62 μm.

Occurrence: KM 3 Merkez Munja (GN 5436); KP 1, 2 upper (GN 5470).
Botanical affinity: Podocarpaceae, *Podocarpus*.

(40) *Podocarpidites verrucorpus* Wu
Pl. 7, fig. 4.

1985 *Podocarpidites verrucorpus* Wu, Zhu et al., Petroleum Indust. Press, p. 130, pl. 16, fig. 12; pl. 17, figs. 6−9.

Description: See Zhu et al. (1985).
Dimensions: Overall width of grain 73 μm; overall length of grain 49 μm; width of central body 39 μm; length of central body 41 μm; width of bladders 40 μm; length of bladders 42−49 μm; proximal cap 8 μm thick.
Occurrence: KM 1, 2 lower (GN 5401).
Botanical affinity: Podocarpaceae, *Podocarpus*.

(41) ? *Podocarpidites* sp.
Pl. 8, fig. 6.

Description: Bisaccate, podocarpoid (?) pollen grain. Outline oval in lateral side-view. Central body narrowly elliptical in lateral side-view; exine finely punctate; proximal cap thin, 1 μm thick. Sacci finely reticulate. Distal furrow between sacci narrow (?), finely punctate or chagrenate.
Dimensions: Overall length of grain 70 μm.
Overall height ofgrain 49 μm.
Length of central body 51 μm.
Height of central body 23 μm.
Length of sacci 60 μm.
Height of sacci 26 μm.
Occurrence: KM 3 Merkez Munja (GN 5436).
Remarks : The authors are reluctant to determine the genus *Podocarpidites* in spite of the bisaccate pollen with larger sacci, because only one specimen which shows a lateral side view was observed.
Botanical affinity: Podocarpaceae (?).

Inaperturate pollen :
Genus: *Cupressacites* Bolkhovitina 1956.
Type species: *Cupressacites russeus* Bolkhovitina 1956.

(42) *Cupressacites* cf. *cuspidataeformis* (Zaklinskaja) Krutzsch
Pl. 5, figs. 7–10.

1957 *Taxus cuspidataeformis* Zaklinskaja, Trudy Geol. Inst., Acad. Sci., USSR, 6, p. 91, pl. 1, figs. 17–18.

1971 *Cupressacites cuspidataeformis* (Zaklinskaja) Krutzsch, Atlas, Lfg. VI, p. 196, pl. 62, figs. 9–18.

Description: See Zaklinskaja (1957) and Krutzsch (1971).
Dimensions: 35–41 μm X 33–41 μm in diameter.
Occurrence: $KM_{1,2}$ lower (GN 5401), middle (GN 5411, GN 5413), and upper (GN 5421); KM_3 Merez Munja (GN 5437); $KP_{1,2}$ lower (GN 5466), middle (GN 5476), and upper (GN 5486).
Botanical affinity: Cupressaceae.

(43) *Cupressacites insulipapillatus* (Trevisan) Krutzsch
Pl. 5, figs. 11–15.

1967 *Inaperturopollenites insulipapillatus* Trevisan, Palaeontographica Italica, 62, N. S. 32, p. 16, pl. 7, fig. 1.

1971 *Cupressacites insulipapillatus* (Trevisan) Krutzsch, Atlas, Lfg. VI, p. 196, pl. 62, figs. 1–8.

Description: See Trevisan (1967) and Krutzsch (1971).
Dimensions: 35–45 μm in diameter.
Occurrence: $KM_{1,2}$ lower (GN 5401) and upper (GN 5421); $KP_{1,2}$ lower (GN 5466) and middle (GN 5476).
Botanical affinity: Cupressaceae.

Genus: *Inaperturopollenites* Pflug & Thomson 1953 emend. Potonié 1958 emend. Potonié 1966.
Type species: *Inaperturopollenites dubius* (Potonié & Venitz 1934) Thomson & Pflug 1953.

(44) *Inaperturopollenites dubius* (Potonié & Venitz) Thomson & Pflug
Pl. 4, figs. 1, 2.

1934 *Pollenites magnus* forma *dubius* Potonié & Venitz, Arb. Inst. Paläobot. Petrogr.

Brennst., 5, p. 17, pl. 2, figs. 20–21.
1953 *Inaperturopollenites dubius* (Potonié & Venitz) Thomson & Pflug, Palaeontographica, B, 94, p 65, pl. 4, fig. 89; pl. 5, figs. 1–13.

Description: See Potonié & Venitz (1934) and Thomson & Pflug (1953),
Dimensions: 31–41 μm X 29–35 μm in diameter.
Occurrence: All horizons. More than 50% from $KM_{1,2}$ lower and middle.
Botanical affinity: Taxodiaceae-Cupressaceae.

(45) *Inaperturopollenites laevigatus* Takahashi
Pl. 4, figs. 3–6.

1957 *Inaperturopollenites laevigatus* Takahashi, Mem. Fac. Sci., Kyushu Univ., Ser. D, Geol., vol. 5, no. 4, pp. 216–217, pl. 38, fig. 18; pl. 39, fig. 16.

Description: See Takahashi (1957).
Dimensions: 20–30 μm in diameter.
Occurrence: $KM_{1,2}$ middle (GN 5411); KM_3 Merkez Munja (GN 5436); $KP_{1,2}$ lower (GN 5466) and middle (GN 5476).
Botanical affinity: Taxodiaceae-Cupressaceae.

(46) *Inaperturopollenites parvus* Takahashi
Pl. 4, figs. 7, 8.

1963 *Inaperturopollenites parvus* Takahashi, Jap. Jour. Geol. Geogr., 34, nos. 2–4, pp. 134–135, pl. 7, figs. 10–11.

Description: See Takahashi (1963).
Dimensions: 14–22 μm in diameter.
Occurrence: $KM_{1,2}$ lower (GN 5411); $KP_{1,2}$ lower (GN 5466).
Botanical affinity: Taxodiaceae-Cupressaceae.

Genus: *Psophosphaera* Naumova 1937 ex Bolkhovitina 1953.
Type species: *Psophosphaera tenuis* Naumova ex Bolkhovitina 1953.

(47) *Psophosphaera aggereloides* (Maljavkina) Chlonova
Pl. 4, figs. 9–11.

1949 *Bullulina aggereloides* f. *glabrescens* Maljavkina, Trudy VNIGRI, no. 33, p. 133, pl. 49, fig. 7.
1960 *Psophosphaera aggereloides* (Maljavkina) Chlonova, Trudy Inst. Geol. Geophys., Acad. Sci. USSR, Siberian Br., 3, pp. 42–43, pl. 5, figs. 11–12.

Description: See Maljavkina (1949) and Chlonova (1960).
Dimensions: 40–49 μm in diameter.
Occurrence: KM $_3$ Merkez Munja (GN 5436); KP $_{1,2}$ lower (GN 5466), middle (GN 5476), and upper (GN 5486).
Botanical affinity: *Larix* or *Pseudotsuga.*

(48) *Psophosphaera pseudotsugoides* Krutzsch
Pl. 4, fig. 12.

1971 *Psophosphaera pseudotsugoides* Krutzsch, Atlas, Lfg. VI, p. 192, pl. 61, figs. 1–6.

Description: See Krutzsch (1971).
Dimensions: 60–110 μm X (35)–109 μm in diameter.
Occurrence: KM $_{1,2}$ lower (GN 5402); KM $_3$ Merkez Munja (GN 5436); KP $_{1,2}$ middle (GN 5476).
Botanical affinity: *Larix* or *Pseudotsuga.*

Genus: *Sequoiapollenites* Thiergart 1938.
Type species: *Sequoiapollenites polyformosus* Thiergart 1938.

(49) *Sequoiapollenites gracilis* Krutzsch
Pl. 4, figs. 13–15; pl. 5, fig. 3.

1971 *Sequoiapollenites gracilis* Krutzsch, Atlas, Lfg. VI, p. 214, pl. 69, figs. 1–34, tab. 13.

Description: See Krutzsch (1971).
Dimensions: 32–37 μm in size; ligura 3–6 μm long.
Occurrence: KM $_{1,2}$ lower (GN 5401) and middle (GN 5411).
Botnical affinity: Taxodiaceae, *Sequoia* .

(50) *Sequoiapollenites largus* (Kremp) Manum
Pl. 5, figs. 1a–b, 2.

1949 cf. *Cryptomeria-Pollenites largus* Kremp, Palaeontographica, B, 90, p. 58, pl. 5, fig. 30.
1962 *Sequoiapollenites largus* (Kremp) Manum, Borsk Polarinst., Skrift. Nr. 125, p. 43.
1971 *Sequoiapollenites largus* (Kremp) Manum, Krutzsch, Atlas, Lfg. VI, pp. 208−210, pl. 67, figs. 1−27.

Description: See Kremp (1949) and Krutzsch (1971).
Dimensions: 37−40 μm X 33−33.5 μm in diameter; ligula 3−7 μm long.
Occurrence: $KM_{1,2}$ lower (GN 5401, GN 5402).
Botanical affinity: Taxodiaceae, *Cryptomeria* .

(51) *Sequoiapollenites* cf. *pilaeligulus* Krutzsch
Pl. 5, fig. 6.

1971 *Sequoiapollenites pilaeligulus* Krutzsch, Atlas, Lfg. VI, p. 224, pl. 74, figs. 11−26.

Description: See Krutzsch (1971).
Dimensions: 30 X 40 μm in diameter; ligula 4 μm long.
Occurrence: $KP_{1,2}$ lower (GN 5466).
Botanical affinity: Taxodiaceae, *Metasequoia* .

(52) *Sequoiapollenites polyformosus* Thiergart
Pl. 5, figs. 4, 5.

1937 *Sequoiapollenites poliformosus* resp. *polyformosus* Thiergart, Jb. Preuß. Geol. L. A., 58, p. 301, pl. 23, figs. 5−11.
1971 *Sequoiapollenites polyformosus* Thiergart, Krutzsch, Atlas, Lfg. VI, p. 212, pl. 68, figs. 1−40.

Description: See Thiergart (1937) and Krutzsch (1971).
Dimensions: 22−28 μm in diameter; ligula 4−5 μm long.
Occurrence: $KM_{1,2}$ lower (GN 5401); KM_3 Merkez Munja (GN 5436); $KP_{1,2}$ middle (GN 5476).
Botanical affinity: Taxodiaceae, *Sequoia* .

(53) *Sequoiapollenites* sp.
Pl. 4, fig. 16.

Description: Smaller conifer pollen grain with a short ligula. Outline trian-

gular due to secondary folds. Exine thin, laevigate. The grain possesses no annular ring which is provided with a short ligula (3 μm long), which is laevigate and tapers off swiftly.
Dimensions: 34 μm in diameter.
Occurrence: KM $_{1,2}$ middle (GN 5411).
Remarks: A single specimen was observed.
Botanical affinity: Taxodiaceae.

Genus: *Zonalapollenites* Pflug 1953.
Type species: *Zonalapollenites igniculus* (R. Potonié 1931) Thomson & Pflug 1953.

(54) *Zonalapollenites maximus* (Raatz) Krutzsch
Pl. 6, fig. 8.

1937 *Tsuga-pollenites igniculus* R. Potonié f. *maximus* Raatz, Abh. Preuß. Geol. L.-A., 183, p. 15, fig. 13.
1971 *Zonalapollenites maximus* (Raatz 1937) Krutzsch, Atlas, Lfg. VI, p. 138, pl. 36, figs. 1–8.

Description: See Raatz (1939) and Krutzsch (1971).
Dimensions: 86 X 82 μm in diameter; frill 6 μm wide.
Occurrence: KM $_{1,2}$ lower (GN 5401).
Remarks: Only one specimen was observed.
Botanical affinity: *Tsuga* .

Monosulcate pollen:
Genus: *Cycadopites* Wodehouse 1933 ex Wilson & Webster 1946.
Type species: *Cycadopites follicularis* Wilson & Webster 1946.

(55) *Cycadopites* sp.
Pl. 11, fig. 10.

Description: Monosulcate pollen grain. Amb long elliptical in distal polar view. Exine two-layered, thin, chagrenate. Sulcus (or colpus) narrow, slightly curved.
Dimensions: 31 X 14 μm in size; width/length ratio: 0.451.
Occurrence: KM $_3$ Kisrakdere W. (GN 5452).

Remarks: The single specimen encountered is no comparable with other species of the genus *Cycadopites* for the time being.
Botanical affinity: Cycadaceae.

Polyplicate pollen:
Genus: *Ephedripites* Bolkhovitina 1953 ex Potonié 1958.
Subgenus: *Ephedripites* (*Ephedripites*) Krutzsch 1961.
Type species: *Ephedripites* (*Ephedripites*) *mediolobatus* Bolkhovitina 1953.

(56) *Ephedripites* (*Ephedripites*) *anatolicus* n. sp.
Pl. 15, figs. 14–16.

Description: Polypliccate pollen grains. Outline long elliptical with rounded poles in equatorial view. Ridges 8 or 9 in number, running parallel from pole to pole, 0.5–1 μm wide. Exine slightly chagrenate or very finely punctate.
Dimensions: 33–37 μm X 12–17.5 μm in size; width/length ratio: 0.363–0.472.
Occurrence: KP $_{1,2}$ lower (GN 5466) and middle (GN 5476).
Holotype: Pl. 15, fig. 14; 37 X 17.5 μm in size; ridges 8 in number, 0.5–1 μm wide; exine slightly chagrenate; width / length ratio: 0.472; KP $_{1,2}$ lower (GN 5466).
Name derivation: From Anatolia district (Turkey).
Comparison: *Ephedripites* (*E.*) *anatolicus* can be distinguished from *Ephedripites* (*E.*) *crassoides* Krutzsch (1961) from the late Oligocene of Germany in having smaller number and narrower width of ridges.
Botanical affinity: Ephedraceae.

(57) *Ephedripites* (*Ephedripites*) *hungaricus* Nagy
Pl. 15, figs. 12, 13.

1963 *Ephedripites* (*Ephedripites*) *hungaricus* Nagy, Grana Palyn., vol. 4, no. 2, p. 278, figs. 1–3; fig. 12 Aa, b.

Description: See Nagy (1963).
Dimensions: 39–49 μm X 14–17 μm in size; ridges 10–11 in number; width/length ratio: 0.346–0.358.
Occurrence: KP $_{1,2}$ lower (GN 5466) and middle (GN 5476).
Botanical affinity: Ephedraceae.

(58) *Ephedripites* (*Ephedripites*) *minor* n. sp.
Pl. 15, figs. 17–19.

Description: Polyplicate pollen grains. Amb narrowly elliptical with rounded poles in equatorial view. Ridges 7 in number, running parallel from pole to pole, thin. Exine slighly chagrenate or finely punctate, up to 1 μm thick.
Dimensions: 25–26 μm X 6–10 μm in size; width/length ratio: 0.24–0.4.
Occurrence: KM $_{1,2}$ upper (GN 5421); KP $_{1,2}$ middle (GN 5476).
Holotype: Pl. 15, fig. 17; 26 X 7 μm in size; ridges 7 in number; exine slightly chagrenate; width/length ratio: 0.269; KP $_{1,2}$ middle (GN 5476).
Name derivation: *minor* (lat.)=smaller.
Comparison: *Ephedripites* (*E.*) *minor* differs from the other species in smaller and narrower shape of the grains. Krutzsch (1961, 1970) has described and illustrated a number of species under the genus *Ephedripites* from the Tertiary of Germany. The Anatolian grains may show some superficial resemblance to some of the grains figured by Krutzsch, but they differ from them either in the shape and size of the garins or in number of ridges. The present specimens are rather comparable with *Ephedripites sulcatus* Brenner, *Ephedripites pentacostatus* Brenner, and *Ephedripites* (*E.*) *minimus* Amerow, but differs from *E.* (*E.*) *sulcatus* in being smaller in size and in having larger number of ridges, from *E.* (*E.*) *pentacostatus* in being larger in size and in possessing larger number of ridges, and from *E.* (*E.*) *minimus* in being larger in size and in having smaller number of ridges.
Botanical affinity: Ephedraceae.

Angiospermous pollen
Inaperturate pollen :
Genus: *Monopunctites* Krutzsch 1970.
Type species: *Monopunctites pliocaenicus* Krutzsch 1970.

(59) *Monopunctites* sp.
Pl. 6, fig. 1.

Description: Inaperturate pollen grain (?). Outline triangular due to secondary folds. Exine thin, finely punctate in dense distribution; no sulcus can be recognized.
Dimensions: 47 μm in diameter.
Occurrence: KM $_3$ Merkez Munja (GN 5436).

Remarks: The single specimen was observed. It is not yet clar, whether this is a pollen or a planktonic form.
Botanical affinity: Unknown.

Genus: *Potamogetonacidites* Sah 1967.
Type species: *Potamogetonacidites cenozoicus* Sah 1967.

(60) *Potamogetonacidites difficilis* Takahashi
Pl. 6, figs. 4−7.

1979 *Potamogetonacidites difficilis* Takahashi, Takahashi & Kim, Palaeontographica, B, 170, p. 35, pl. 8, figs. 15−21.

Description: See Takahashi & Kim (1979).
Dimensions: 26−37 μm X 24−29 μm in diameter; muri baculate, 1 μm high; lumina of reticulum less than 2 or 3 μm.
Occurrence: $KM_{1,2}$ lower (GN 5401); $KP_{1,2}$ middle (GN 5476) and upper (GN 5 487, GN 5490).
Botanical affinity: Potamogetonaceae.

Genus: *Smilacipites* Wodehouse 1933.
Type species: *Smilacipites echinatus* Wodehouse 1933.

(61) *Smilacipites* sp.
Pl. 6, figs. 2a−b.

Description: Inaperturate pollen grain with circular outline and with moderately distributed conical spines. Exine finely punctate between conical spines, 1.5 μm thick, with secondary folds. Spines conical, distributed at moderate intervals, 0.5−1 μm high.
Dimensions: 55 X 47 μm in diameter.
Occurrence: $KP_{1,2}$ middle (GN 5477).
Remarks: The single specimen was observed.
Botanical affinity: ? *Smilax*.

(62) ? *Smilacipites* sp.
Pl. 6, fig. 3.

Description: Inaperturate pollen grain with subcircular outline and with very fine spines. Exine thin, smooth, folded secondarily. Spines very fine, 1 μm high, distributed at moderate spaces.
Dimensions: 23 μm in diameter.
Occurrence: KM_3 Merkez Munja (GN 5437)
Remarks: Only one specimen was encountered.
Botanical affinity: ? *Smilax* and otherwise.

Monocolpate (Monosulcate) pollen:
Genus: *Arecipites* Wodehouse 1933.
Type species: *Arecipites punctatus* Wodehouse 1933.

(63) *Arecipites brandenburgensis* Krutzsch
Pl. 11, figs. 18, 19.

1970 *Arecipites brandenburgensis* Krutzsch, Atlas, Lfg. VII, p. 106, pl. 22, figs. 8–18.

Description: See Krutzsch (1970).
Dimensions: 28–31 μm X 19–20 μm in size; sulcus curved; muri baculate, semitectate, 1.2 μm high; lumina or reticulum 2–2.5 μm or less; width/length ratio: 0.612–0.714.
Occurrence: $KM_{1,2}$ lower (GN 5401, GN 5402).
Botanical affinity: Palmae.

(64) *Arecipites pflugii* (Takahashi) Krutzsch
Pl. 11, fig. 17.

1961 *Monocolpopollenites pflugii* Takahashi, Mem. Fac. Sci., Kyushu Univ., Ser. D, Geol., vol. 11, no. 3, p. 294, pl. 16, figs. 31–32
1970 *Arecipites pflugii* (Takahashi) Krutzsch, Atlas, Lfg. VII, p. 29.

Description: See Takahashi (1961).
Dimensions: 32 X 21 μm in size; muri baculate, 0.5 μm high; lumina of reticulum less than 2 μm in diameter; width/length ratio: 0.656.
Occurrence: $KP_{1,2}$ middle (GN 5476).
Botanical affinity: ? Palmae.

(65) *Arecipites* sp.

Pl. 11, fig. 20.

Description: Monocolpate pollen grain. Outline elliptical or prolate with rounded corners in polar view. Colpus slender, straight, reaching both corners. Exine finely reticulate; lumina of reticulum 1.5−3 μm in diameter; muri baculate-clavate, 1 μm high.
Dimensions: 21 X 13 μm in size; width/length ratio: 0.619.
Occurrence: KM$_{1,2}$ lower (GN 5401).
Remarks: The single specimen was observed. The authors cannot identify it with a known species of *Arecipites*.
Botanical affinity: Palmae.

Genus: *Monocolpopollenites* Pflug & Thomson 1953.
Type species: *Monocolpopollenites tranquillus* (Potonié 1934) Thomson & Pflug 1953.

(66) *Monocolpopollenites intrabaculatus* Takahashi
Pl. 11, fig. 12.

1961 *Monocolpopollenites intrabaculatus* Takahashi, Mem. Fac. Sci., Kyushu Univ., Ser. D, Geol., vol. 11, no. 3, p. 293, pl. 16, figs. 24−27.

Description: See Takahashi (1961).
Dimensions: 22 X 16 μm in size; exine 0.5 μm on side and 1.5 μm on poles, intrabaculate; width/length ratio: 0.727.
Occurrence: KP$_{1,2}$ middle (GN 5476).
Botanical affinity: Palmae.

(67) *Monocolpopollenites kyushuensis* Takahashi
Pl. 11, figs. 11, 13, 14.

1961 *Monocolpopollenites kyushuensis* Takahashi, Mem. Fac. Sci., Kyushu Univ., Ser. D, Geol., vol. 11, no. 3, p. 292, pl. 16, figs. 17−23.

Description: See Takahashi (1961).
Dimensions: 21−24 μm X 13−15 μm in size; exine thin, chagrenate; width/length ratio: 0.590−0.666.
Occurrence: KM$_3$ Merkez Munja (GN 5436) and Kisrakdere W. (GN 5452); KP

1, 2 upper (GN 5486).
Botanical affinity: Palmae.

(68) *Monocolpopollenites tranquillus* (Potonié) Thomson & Pflug
Pl. 11, figs. 15, 16.

1934 *Pollenites tranquillus* Potonié, Arb. Inst. Paläobot. Petrogr. Brennst., Peuß. Geol. L.-A., 4, p. 51, pl. 2, figs. 3, 8.
1951 *Palmae-pollenites tranquillus* Potonié, Mürriger & Pflug, Notizb. Hess. L.-A. Bodenforsch., 6, pp. 88, 89, 90, 92, 93, 96, pl. 5, figs. 2–5.
1953 *Monocolpopollenites tranquillus* (Potonié) Thomson & Pflug, Palaeontographica, B, 94, p. 62, pl. 4, figs. 24–37, 39–47.

Description: See Potonié (1934) and Thomson & Pflug (1953).
Dimensions: 27 X 16 μm in size; exine thin, 0.5 μm thick on side and 1.5 μm thick on poles; width/length ratio: 0.592.
Botanical affinity: Palmae.

Genus: *Monosulcites* Cookson 1947 ex Couper 1953.
Type species: *Monosulcites minimus* Cookson 1947.

(69) *Monosulcites* sp.
Pl. 11, fig. 21.

Description: Monosulcate pollen grain. Outline broad-elliptical or subprolate with rounded apices in distal polar view. Sulcus distinct, narrow, straight and extending to near both apices. Ectexine baculate-verrucate-semitectate, 1 μm high; verrucae 1 μm in diameter.
Dimensions: 34 X 26 μm in size, W/L=0.764.
Occurrence: $KM_{1,2}$ lower (GN 5401).
Remarks: A single specimen was observed.
Botanical affinity: ? Araceae.

Monoporate pollen :
Genus: *Graminidites* Cookson 1947 ex Potonié 1960.
Type species: *Graminidites media* Cookson 1947 ex Potonié 1960.

(70) *Graminidites laevigatus* Krutzsch

Pl. 19, figs. 1–3.

1970 *Graminidites laevigatus* Krutzsch, Atlas, Lfg. VII, p. 60, pl. 5, figs. 1. 12.

Description: See Krutzsch (1970).
Dimensions: 27–43 μm in diameter; pore 3–5 μm in diameter; anulus ring 3–5 μm in diameter; exine laevigate to somewhat chagrenate.
Occurrence: $KM_{1,2}$ middle (GN 5412); KM_3 Kisrakdere W. (GN 5457); $KP_{1,2}$ middle (GN 5476).
Botanical affinity: Gramineae.

(71) *Graminidites* cf. *laevigatus* Krutzsch
Pl. 18, fig. 18.

Dimensions: 32 μm in diameter; pore 4 μm in diameter; anulus ring 7 μm in diameter.
Occurrence: $KM_{1,2}$ upper (GN 5486).
Botanical affinity: Gramineae.

(72) *Graminidites subtiliglobosus*: (Trevisan) Krutzsch
Pl. 18, figs. 15–17.

1970 *Graminidites subtiliglobosus* (Trevisan) Krutzsch, Atlas, Lfg. VII, p. 54, pl. 2, figs. 1–12.

Description: See Trevisan (1967) and Krutzsch (1970).
Dimensions: 29–33 μm in diameter; pore 2–5 μm in diameter; anulus ring 6.5–10 μm in diameter; exine thin, finely punctate.
Occurrence: $KM_{1,2}$ upper (GN 5421); KM_3 Kisrakdere W. (GN 5451); $KP_{1,2}$ lower (GN 5466 and GN 5468), and middle (GN 5476).
Botanical affinity: Gramineae.

(73) *Graminidites* sp.
Pl. 18, fig. 19.

Description: Monoporate pollen grain. Figura elliptical in outline. A pore 2.5 μm in diameter; anulus ring large, ca. 12 μm in diameter. Exine thin, more or less chagrenate.

Dimensions: 44 X 30 μm in size.
Occurrence: KM 1, 2 middle (GN 5412).
Botanical affinity: Gramineae.

Polycolpate pollen:
Genus: *Ranunculacidites* Sah 1967.
Type species: *Ranunculacidites communis* Sah 1967.

(74) *Ranunculacidites* sp.
Pl. 15, figs. 11a–b.

Description: Polycolpate pollen grain. Outline circular in polar view. Each of three colpi makes a pair; they are radially placed and converge gradually towards the poles. Exine finely reticulate; muri baculate to tectate, 1.5 μm thick; net lumina less than 3.5 μm in diameter.
Dimensions: 32 X 31 μm in equatorial diameter.
Occurrence: KP 1, 2 lower (GN 5466).
Remarks: Hitherto, pollen grains of the genus *Ranunculacidites* occurred often from the Tertiary in subtropical and tropical regions.
Botanical affinity: Labiatae, Ranunculaceae or Punicaceae.

Genus: *Tetracolpites* Vimal ex Srivastava 1966.
Type species: *Tetracolpites reticulatus* Srivastava 1966

(75) *Tetracolpites* sp.
Pl. 15, fig. 6.

Description: Four-colpate pollen grain. Outline broad-elliptical in equatorial view. Four colpi run almost parallel toward the poles. Exine thin, 1 μm thick, weakly intrabaculate; ectexine is as thick as endexine.
Dimensions: 28 X 21 μm in size; width/length ratio=0.75.
Occurrence: KP 1, 2 middle (GN 5476).
Botanical affinity: Unknown.

Polyporate pollen:
Genus: *Carpinuspollis* Takahashi 1979.
Type species: *Carpinuspollis carpinoides* (Pflug 1953) Takahashi 1979.

(76) *Carpinuspollis carpinoides* (Pflug) Takahashi
Pl. 22, figs. 10, 11.

1953 *Polyporopollenites carpinoides* Pflug, Thomson & Pflug, Palaeontographica, B, 94, p. 92, pl. 10, figs. 79–84.
1979 *Carpinuspollis carpinoides* (Pflug 1953) Takahashi, Takahashi & Kim, Palaeontographica, B, 170, pp. 58–59

Description: See Pflug in Thomson & Pflug (1953) and Takahashi in Takahashi & Kim (1979).
Dimensions: 33 – 37 μm X 30 – 33 μm in diameter; 5 pores 4 μm in diameter, with weak anulus (10 μm in diameter) and weak labrum; exine 0.5–1 μm thick.
Occurrence: $KM_{1,2}$ upper (GN 5421) and $KP_{1,2}$ lower (GN 5466).
Botanical affinity: Betulaceae, *Carpinus*.

Genus: *Chenopodipollis* Krutzsch 1966.
Type species: *Chenopodipollis multiplex* (Weyland & Pflug 1957) Krutzsch 1966.

(77) *Chenopodipollis multiplex* (Weyland & Pflug) Krutzsch
Pl. 22, figs. 16, 17.

1957 *Periporopollenites multiplex* Weyland & Pflug, Palaeontographica, B, 102, p. 103, pl. 22, figs. 18, 19.
1966 *Chenopodipollis* (al. *Periporopollenites*) *multiplex* (Weyland & Pflug 1957) Krutzsch, Geologie, Jrg. 15, Beih. 55, p. 35, pl. 7, figs. 22–25.

Description: See Weyland & Pflug (1957) and Krutzsch (1966).
Dimensions: 24 – 30 μm X 23 – 28 μm in diameter; 21 – 22 or 23 – 24 pores on the hemisphere; pores 2–2.5 μm in diameter.
Occurrence: $KP_{1,2}$ lower (GN 5466) and middle (GN 5476).
Botanical affinity: Chenopodiaceae.

Genus: *Polyatriopollenites* Pflug 1953.
Type species: *Polyatriopollenites stellatus* (Potonié 1931) Pflug 1953.

(78) *Polyatriopollenites stellatus* (Potonié) Pflug
Pl. 22, figs. 12–15.

1931 *Pollenites stellatus* Potonié, Jb. Preuss. Geol. L. A. f., 52, p. 4, fig. 20.
1953 *Polyatriopollenites stellatus* (Potonié) Pflug, Palaeontographica, B, 95, p. 115, pl. 24, fig. 47.

Description: See Potonié (1931) and Pflug (1953).
Dimensions: 35−44 μm X 28−38 μm in diameter; exine 0.8−1 μm thick; 6 pores; side straight or weakly convex or concave; weak anulus or no anulus and no labrum.
Occurrence: $KM_{1,2}$ upper (GN 5421) and (GN 5423); $KP_{1,2}$ lower (GN 5466).
Botanical affinity: Juglandaceae, *Pterocarya*.

Genus: *Polyvestibulopollenites* Pflug 1953.
Type species: *Polyvestibulopollenites verus* (Potonié 1931) Thomson & Pflug 1953.

(79) *Polyvestibulopollenites verus* (Potonié) Thomson & Pflug
Pl. 22, figs. 7−9.

1931 *Pollenites verus* Potonié, Z. Braunkohle, H. 16, 30. Jrg. p. 332, pl. 2, fig. 40.
1953 *Polyvestibulopollenites* (*Alnipollenites*) *verus* (Potonié) Thomson & Pflug, Palaeontographica, B, 94, p. 70, pl. 10, figs. 62−76

Description: See Potonié (1931) and Thomson & Pflug (1953).
Dimensions: 27−28 μm in diameter; 5 pores.
Occurrence: $KM_{1,2}$ lower (GN 5401) and middle (GN 5411−5413); $KP_{1,2}$ lower (GN 5466) and upper (GN 5486).
Botanical affinity: Betulaeceae, *Alnus*.

Genus: *Ulmipollenites* Wolff 1934.
Type species: *Ulmipollenites undulosus* Wolff 1934.

(80) *Ulmipollenites undulosus* Wolff
Pl. 21, fig. 15, pl. 22, fig. 4.

1934 *Ulmipollenites undulosus* Wolff, Arb. Inst. Paläobot., Petrogr. Brennst., 5, p. 75, pl. 5, fig. 25.

Description: See Wolff (1934).

Dimensions: 33−38 μm in diameter; 4−5 pores; exine undulate.
Occurrence: $KM_{1,2}$ lower (GN 5401), middle (GN 5411), and upper (GN 5421−5422); KM_3 Merkez Munja (GN 5436) and Kisrakdere W. (GN 5451); $KP_{1,2}$ lower (GN 5466), middle (GN 5476), and upper (GN 5486).
Botanical affinity: Ulmaceae, *Ulmus* .

Genus: *Zelkovaepollenites* Nagy 1969.
Type species: *Zelkovaepollenites potoniei* Nagy 1969.

(81) *Zelkovaepollenites potoniei* Nagy
Pl. 21, fig. 16; pl. 22, figs. 1−3, 5, 6.

1969 *Zelkovaepollenites potoniei* Nagy, Ann. Hung. Geol. Inst., 52, no. 2, p. 457, pl. 51, figs. 17, 20.

Description: See Nagy (1969).
Dimensions: 26−44 μm in diameter; 4−6 pores; exine undulate.
Occurrence: $KM_{1,2}$ lower (GN 5401), middle (GN 5412), and upper (GN 5421−5422); KM_3 Kisrakdere W. (GN 5452); $KP_{1,2}$ lower (GN 5466) and middle (GN 5476).
Botanical affinity: Ulmaceae, *Zelkova* .

Tricolpate pollen :
Genus: *Cupuliferoidaepollenites* Potonié, Thomson & Thiergart 1950 ex Potonie 1960.
Type species: *Cupuliferoidaepollenites liblarensis* (Thomson 1950) Potonié 1960.

(82) *Cupuliferoidaepollenites facetus* (Takahashi) Takahashi
Pl. 13, figs. 11, 12.

1961 *Tricolpopollenites facetus* Takahashi, Mem. Fac. Sci., Kyushu Univ., Ser. D, Geol., vol. 11, no. 3, pp. 314−315, pl. 23, fig. 15.
1979 ? *Cupuliferoidaepollenites facetus* (Takahashi) Takahashi, Takahashi & Kim, Palaeontographica, B, 170, p. 37, pl. 9, fig. 6.

Description: See Takahashi (1961).
Dimensions: 23 X 18 μm in size; 19 μm in equatorial diameter (in polar view); exine laevigate, 0.5−1 μm thick; width/length ratio=0.782−1.0.

Occurrence: $KM_{1,2}$ lower (GN 5401); KM_3 Merkez Munja (GN 5436).
Botanical affinity: Unknown.

(83) *Cupuliferoidaepollenites fallax* (Potonié) Potonié
Pl. 13, figs. 7–10.

1934 *Pollenites fallax* Potonié, Arb. Inst. Paläobot. Petrogr. Brennst., 4, pl. 70, fig. 10.
1986 *Cupuliferoidaepollenites fallax* (Potonié) Potonié, Takahashi & Jux, Bull. Fac. Liberal Arts, Nagasaki Univ., Nat. Sci., vol. 26, no. 2, pp. 132–133, pl. 22, fig. 21; pl. 27, figs. 15–16.

Description: See Potonié (1934).
Dimensions: 17–19 μm X 9–11 μm in size; exine laevigate, 0.5 μm think; width/length ratio=0.529–0.578.
Occurrence: $KM_{1,2}$ lower (GN 5401); KM_3 Merkez Munja (GN 5436); $KP_{1,2}$ lower (GN 5466) and upper (GN 5486).
Botanical affinity: Leguminosae, Cupuliferoidae and other herbs are mentioned (Potonié, 1934; Thomson & Pflug, 1953; Nagy, 1985).

(84) *Cupuliferoidaepollenites longus* n. sp.
Pl. 13, figs. 14, 15.

Description: Tricolpate pollen grains. Amb long-elliptical or perprolate in equatorial view. Three colpi run parallel from pole to pole. Exine two-layered, smooth, 0.5 μm thick on the side and 1.0–1.5 μm thick in the polar areas; ectexine is as thick as endexine.
Dimensions: 25–29 μm X 10–13 μm in size; width/length ratio=0.37–0.45.
Occurrence: $KM_{1,2}$ middle (GN 5412); $KP_{1,2}$ lower (GN 5466).
Holotype: Pl. 13, fig. 14; 29 X 13 μm in size; exine laevigate, 0.5 μm think on the side and 1.5 μm thick in the polar areas; width/length ratio=0.45; $KP_{1,2}$ lower (GN 5466).
Name derivation: *longus* (lat.)=long.
Remarks: The present specimens are closely similar to *Cupliferoidaepollenites lanceolatus* Takahashi & Sugiyama from the Santonian Uge Member of the Taneichi Formation in the Tohoku district, but differ by their larger size.
Botanical affinity: Unknown.

(85) *Cupuliferoidaepollenites vulgaris* (Takahashi) Takahashi

Pl. 13, figs. 16–21; pl. 14, figs. 1–7.

1957 *Tricolpopollenites vulgaris* Takahashi, Mem. Fac. Sci., Kyushu Univ., Ser. D, Geol., vol. 5, no. 4, p. 218, pl. 38, figs. 44–45; pl. 39, fig. 38.

1979 *Cupuliferoidaepollenites vulgaris* (Takahashi) Takahashi, Takahashi & Kim, Palaeontographica, B, 170, p. 37, pl. 9, figs. 7–8.

Description: See Takahashi (1957) and Takahashi in Takahashi & Kim (1979).
Dimensions: 21–24 μm X 9–14 μm in size; width/length ratio=0.41–0.636.
Occurrence: $KM_{1,2}$ lower (GN 5401), middle (GN 5412), and upper (GN 5421, 5422); KM_3 Merkez Munja (GN 5436) and Kisrakdere W. (GN 5451); $KP_{1,2}$ lower (GN 5466) and upper (GN 5486).
Botanical affinity: Cupuliferae.

(86) *Cupuliferoidaepollenites weylandii* (Takahashi) Takahashi
Pl. 13, fig. 13.

1961 *Tricolpopollenites weylandii* Takahashi, Mem. Fac. Sci., Kyushu Univ., Ser. D, Geol., vol. 11, no. 3, pp. 313–314, pl. 23, figs. 1–4.

1979 *Cupuliferoidaepollenites weylandii* (Takahashi) Takahashi, Takahashi & Kim, Palaeontographica, B, 170, Lfg. 1–3, p. 37, pl. 9, fig. 9.

Description: See Takahashi (1961) and Takahashi in Takahashi & Kim (1979).
Dimensions: 28 μm X 14–18 μm in size; width/length ratio=0.5–0.642.
Occurrence: $KM_{1,2}$ middle (GN 5411); $KP_{1,2}$ lower (GN 5466).
Botanical affinity: ? Cupuliferae.

Genus: *Quercoidites* Potonié, Thomson & Thiergart 1950 ex Potonié 1960.
Type species: *Quercoidites henrici* (Potonié 1931) Potonié 1960.

(87) *Quercoidites densus* (Pflug) Song & Zheng
Pl. 12, figs. 7–11.

1953 *Tricolpopollenites densus* Pflug, Thomson & Pflug, Palaeontographica, B, 94, p. 96, pl. 11, figs. 55–58.

1981 *Quercoidites* cf. *densus* (Pflug) Song & Zheng, Song et al., Geol. Publ. House, Peking, China, pp. 119–120, pl. 37, fig. 21.

Description: See Pflug in Thomson & Pflug (1953).

Dimensions: 25–30 μm X 21.5–26 μm in size; exine 0.5–1 μm thick; width/length ratio=0.83–0.98.
Occurrence: KM_3 Merkez Munja (GN 5436); $KP_{1,2}$ lower (GN 5466) and middle (GN 5476).
Botanical affinity: Fagaceae, *Quercus*.

(88) *Quercoidites henrici* (Potonié) Potonié, Thomson & Thiergart
Pl. 12, figs. 16–24.

1931 *Pollenites henrici* Potonié, Z. Braunkohle, H. 16, p. 332, tab. 2, fig. 14.
1950 *Quercoidites henrici*(Potonié) Potonié, Thomson & Thiergart, Geol. Jb., 65, p. 54, pl. 3, figs. 22–23.

Description: See Potonié (1931).
Dimensions: 26–35 μm X 13–19 μm in size; exine weakly intrabaculate, 0.5–1 μm thick on the side and 0.8–2 μm thick in the polar areas; width/length ratio=0.42–0.69.
Occurrence: $KM_{1,2}$ lower (GN 5401), middle (GN 5411), and upper (GN 5422); KM_3 Merkez Munja (GN 5436) and Kisrakdere W. (GN 5452); $KP_{1,2}$ lower (GN 5466) and middle (GN 5476).
Botanical affinity: Fagaceae, *Quercus*.

(89) *Quercoidites microdensus* Takahashi & Jux
Pl. 12, figs. 12–15.

1982 *Quercoidites microdensus* Takahashi & Jux, Bull Fac. Liberal Arts, Nagasaki Univ., Nat. Sci., vol. 23, no. 1, pp. 42–43, pl. 5, figs. 1–7.

Description : See Takahashi & Jux (1982).
Dimensions: 22–25 μm X 16–20 μm in size; exine 0.5 μm thick on the side and 1 μm thick in the polar areas; width/length ratio=0.72–0.87.
Occurrence: $KM_{1,2}$ lower (GN 5401) and middle (GN 5411); $KP_{1,2}$ lower (GN 5466), middle (GN 5476), and upper (GN 5486).
Botanical affinity: Probably Cupuliferae.

(90) *Quercoidites microhenrici* (Potonié) Potonié
Pl. 13, figs. 1–6, 37–39.

1931 *Pollenites microhenrici* Potonié, Sitz. Ber. Ges. Naturf. Fr., nos. 1−3, pl. 26, pl. 26, pl. 1, fig. 19c.
1960 *Quercoidites microhenrici* (Potonié) Potonié, Beih. Geol. Jb., 39, p. 93.

Description: See Potonié (1931).
Dimensions: 21−31 μm X 12−18 μm in size; exine weakly intrabaculate, 0.5 μm thick on the side and 1−1.5 μm thick in polar areas; width/length ratio= 0.46−0.67.
Occurrence: KM $_{1,2}$ lower (GN 5402), middle (GN 5411), and upper (GN 5422); KM $_3$ Merkez Munja (GN 5436) and Kisrakdere W.(GN 5451); KP $_{1,2}$ lower (GN 5466).
Botanical affinity: Fagaceae, *Quercus* .

(91) *Quercoidites* cf. *punctatus* Takahashi & Jux
Pl. 12, fig. 25.

1989 *Quercoidites punctatus* Takahashi & Jux, Bull. Fac. Liberal Arts, Nagasaki Univ., Nat. Sci., vol. 29, no. 2, p. 404, pl. 11, figs. 10−12.

Description: See Takahashi & Jux (1989).
Dimensions: 27 X 19 μm thick in size; exine 1 μm thick on the side, 2 μm thick in polar areas; ectexine intrabaculate and endexine laevigate; width/ length ratio=0.703.
Occurrence: KM $_{1,2}$ lower (GN 5401).
Botanical affinity: Probably Cupuliferae.

(92) *Quercoidites somaensis* n. sp.
Pl. 12, figs. 1−6.

Description: Tricolpate pollen grains. Outline elliptical or prolate to subprolate in equatorial view. Three colpi conspicuous and converging to the poles. Exine 0.5 μm thick on the side and 1−1.5 μm thick in polar regions, intrabaculate.
Dimensions: 33−36 μm X 23−31 μm in size; width/length ratio=0.696−0.861.
Occurrence: KM $_3$ Kisrakdere W. (GN 5452); KP $_{1,2}$ lower (GN 5466).
Holotype: Pl. 12, figs. 1a, b; 36 X 26 μm in size; exine intrabaculate, 0.5 μm thick on the side and 1 μm thick in polar regions; width/ length ratio=0.722; KM $_{1,2}$ lower (GN 5466).

Name derivation: From Soma city.
Remarks: *Quercoidites somaensis* n. sp. is larger and wider than *Quercoidites henrici* and *Q. microhenrici*, and larger than *Q. densus* and *Q. microdensus*.
Botanical affinity: Fagaceae, *Quercus*.

Genus: *Retitrescolpites* Sah 1967.
Type species: *Retitrescolpites typicus* Sah 1967.

(93) *Retitrescolpites globosus* n. sp.
Pl. 14, figs. 24 a–b; pl. 15, figs. 7–10.

Description: Tricolpate pollen grains. Figura globular or subglobular in polar and equatorial views. Three colpi are long, arranged in radial symmetry, gaped and extending near to the poles where they converge. Exine reticulate; lumina of reticulum polygonal, 4–6 μm in diameter; muri baculate or partially tectate, 2–4 μm high.
Dimensions: 34–35 μm X 29–30 μm in size in equatorical view; 33–35 μm X 27–31 μm in diameter in polar view.
Occurrence: $KM_{1,2}$ lower (GN 5401) and (GN 5402).
Holotype: Pl. 15, figs. 7a, b; 35 X 31 μm in diameter in somewhat oblique view; exine roughly reticulate; lumina of reticulum 4.5–5 μm in diameter; muri baculate-partially tectate, 2.5–3 μm high; $KM_{1,2}$ lower (GN 5402).
Name derivation: *globosus* (lat.)= spherical, globe-shaped.
Remarks: The present specimens are compared with Oleaceae-pollen with roughly reticulate exine *Retitrescopites splendens* Sah, *R. kivuensis* Sah, and *R. decipiens* Sah from upper Neogene sediments of Rusizi valley (Burundi, Africa) (1967), but differ in being much smaller in size.
Botanical affinity: Oleaceae.

(94) *Retitrescolpites* sp. a
Pl. 14, fig. 20.

Description: Tricolpate pollen grain. Outline elliptical or prolate in equatorial view. Three colpi slender and running parallel towards the poles. Exine roughly reticulate; lumina of reticulum polygonal, 2–4 μm in diameter; muri baculate-partially tectate, 1 μm high.
Dimensions: 23 X 13 μm in size; width/length ratio=0.565.
Occurrence: KM_3 Kisrakdere W. (GN 5451).

Remarks: Only one specimen was observed.
Botanical affinity: ? Oleaceae.

(95) *Retitrescolpites* sp. b
Pl. 14, fig. 23.

Description: Tricolpate pollen grain. Amb rounded-triangular or subcircular in polar view. Three colpi somewhat inconspicuous and converging to the poles. Exine reticulate; net lumina polygonal, less than 3.5 μm in diameter; muri baculate, 1.5 μm high.
Dimensions: 26 X 26 μm in equatorial diameter.
Occurrence: KM_3 Kisrakdere W. (GN 5451).
Remarks: A single specimen was found. This is smaller than *Retitrescolpites typicus* Sah (1967) from upper Neogene sediments of Burundi, Africa.
Botanical affinity: Oleaceae.

Genus: *Striatopollis* Krutzsch 1959.
Type species: *Striatopollis sarstedtensis* Krutzsch 1959.

(96) *Striatopollis circularis* n. sp.
Pl. 14, fig. 25; pl. 15, figs. 1−3.

Description: Tricolpate pollen grains. Outline circular to subcircular in polar, oblique and equatorial views. Three colpi conspicuous, arranged in symmetry, and converging to the apices. Exine two-layered, very delicately and complexly striated; muri baculate-tectate or semitectate, 0.5−1.3 μm high.
Dimensions: 25−30 μm X 21−25 μm in diameter in polar and oblique views; 37 X 32 μm in size in equatorial view, width/length ratio=0.865.
Occurrence: $KM_{1,2}$ lower (GN 5401); $KP_{1,2}$ lower (GN 5466) and upper (GN 5486).
Holotype: Pl. 15, fig. 1; 25 μm in diameter in somewhat oblique view; exine delicately and complexly striated; muri tectate, 1.3 μm high; $KM_{1,2}$ lower (GN 5401).
Name derivation: *circularis* (lat.)=circular.
Remarks: The new species differs from *Striatopollis striatellus* (Takahashi) Takahashi in having spherical form and *S. variabilis* Takahashi & Jux in being smaller in size.
Botanical affinity: Unknown.

(97) *Striatopollis* sp.
Pl. 15, figs. 4, 5.

Description: Tricolpate pollen grains. Figura ellipsoidal or prolate to perprolate in equatorial view. Three colpi slender and running almost parallel to the apices. Exine finely striated; muri baculate, 0.5−1.5 μm high.
Dimensions: 33−36 μm X 15−24 μm in size; width/length ratio=0.428−0.727.
Occurrence: KM_3 Kisrakdere W. (GN 5452); $KP_{1,2}$ lower (GN 5466) and middle (GN 5476).
Remarks: Four specimens were observed. However, the authors could not identify them specifically.
Botanical affinity: Unknown.

Genus: *Tricolpites* Cookson 1947 ex Couper 1953 emend. Belsky, Boltenhagen & Potonié 1965.
Type species: *Tricolpites reticulatus* Cookson 1947 ex Couper 1953.

(98) *Tricolpites minutireticulosus* Takahashi
Pl. 14, fig. 17.

1979 *Tricolpites minutireticulosus* Takahashi, Takahashi & Kim, Palaeontographica, B, 170, Lfg. 1−3, p. 40, pl. 10, figs. 5−8.

Description: See Takahashi in Takahashi & Kim (1979).
Dimensions: 17 X 10.5 μm in size; width/length ratio=0.62.
Occurrence: $KM_{1,2}$ lower (GN 5401).
Botanical affinity: *Salix* or *Platanus*.

(99) *Tricolpites retiformis* (Pflug & Thomson) Takahashi & Jux
Pl. 14, fig. 18.

1953 *Tricolpopollenites retiformis* Pflug & Thomson, Thomson & Pflug, Palaeontographica, B, 94, p. 97, pl. 11, figs. 59−61.
1982 *Tricolpites retiformis* (Pflug & Thomson) Takahashi & Jux, Bull. Fac. Liberal Arts, Nagasaki Univ., Nat. Sci., vol. 23, no. 1, p. 45, pl. 5, fig. 23

Description: See Pflug & Thomson in & Thomson & Pflug (1953).
Dimensions: 24−28 μm X 12−24 μm in size; lumina of reticulum 2−3 μm or

less in diameter; muri baculate, 1 μm high; width/length ratio=0.428–0.888.
Occurrence: KM 1, 2 lower (GN 5401); KM 3 Kisrakdere W. (GN 5452); KP 1, 2 lower (GN 5466) and middle (GN 5476).
Botanical affinity: Salicaceae, *Salix*.

(100) *Tricolpites rudis* (Takahashi) Takahashi & Sugiyama
Pl. 14, figs. 15 a–b.

1961 *Tricolpopollenites rudis* Takahashi, Mem. Fac. Sci., Kyushu Univ., Ser. D, Geol., vol. 11, no. 3, pp. 319–320, pl. 24, figs. 1–13.
1990 *Tricolpites rudis* (Takahashi) Takahashi & Sugiyama, Bull. Fac. Liberal Arts, Nagasaki Univ., Nat. Sci., vol. 30, no. 2, pp. 344–345, pl. 91, fig. 17; pl. 92, fig. 7.

Description: See Takahashi (1961).
Dimensions: 29 X 29 μm in size in somewhat oblique view; muri baculate-tectate, 2 μm high; net lumina less than 2 μm in diameter.
Occurrence: KP 1, 2 lower (GN 5466).
Botanical affinity: Unknown.

(101) *Tricolpites tecturatus* n. sp.
Pl. 14, figs. 16 a–b, 19.

Description: Tricolpate pollen grains. Amb elliptical or prolate in equatorial view. Three colpi conspicuous, strong, running almost parallel towards the apices and converging to the poles. Exine two-layered, finely reticulate; muri baculate-tectate, 1–1.2 μm high; lumina of reticulum less than 1–1.5 μm in diameter.
Dimensions: 25–26 μm X 16 μm in size; width/length ratio=0.615–0.64.
Occurrence: KP 1, 2 lower (GN 5466) and middle (GN 5476).
Holotype: Pl. 14, figs. 16 a–b; 25 X 16 μm in size; exine finely reticulate; lumina of reticulum less than 1 μm in diameter; muri tectate, 1.2 μm high; KP 1, 2 lower (GN 5466).
Name derivation: *tecturatus* (lat.)=tectorial, covering.
Remarks: Only a few grains of this type have been found. This new species differs from the others of *Tricolpites* in general form and organisation.
Botanical affinity: Salicaceae, *Salix*.

(102) *Tricolpites* sp. a

Pl. 14, fig. 21.

Description: Tricolpate pollen grain. Outline circular in oblique view. Three colpi conspicuous, gaped, arranged in radial symmetry, and converging near to the poles. Exine finely reticulate; net lumina less than 2 μm in diameter; muri tectate, 1 μm high.
Dimensions: 30 X 30 μm in size.
Occurrence: $KP_{1,2}$ middle (GN 5476).
Remarks: A single specimen observed is closely similar to *Tricolpites rudis* (Takahashi) Takahashi & Sugiyama, but seems to differ in having somewhat larger lumina of reticulum.
Botanical affinity: Unknown.

(103) *Tricolpites* sp. b
Pl. 14, fig. 22.

Description: Tricolpate pollen grain. Outline rounded-triangular in oblique view. Three colpi slender, gaped, and arranged in radial symmetry. Exine finely reticulate; lumina of reticulum, 1.5 μm in diameter; muri tectate, 0.5 μm high.
Dimensions: 21 X 20 μm in size.
Occurrence: $KP_{1,2}$ upper (GN 5486).
Botanical affinity: Unknown.

Genus: *Tricolpopollenites* Pflug & Thomson 1953.
Type species: *Tricolpopollenites parmularis* (Potonié) Thomson & Pflug 1953.

(104) *Tricolpopollenites anatolicus* n. sp.
Pl. 13, figs. 23−27.

Descriptipn: Tricolpate pollen grains. Figura broad-ellipsoidal or prolate to subprolate in equatorial view. Three colpi conspicuous, arranged radially in symmetry, and converging to the poles. Exine two-layered, finely granulate to punctate, less than 1 μm thick; muri finely baculate-partially tectate or intrabaculate.
Dimensions: 25−28 μm X 20−23 μm in size; width/length ratio=0.74−0.88.
Occurrence: $KM_{1,2}$ lower (GN 5401); KM_3 Merkez Munja (GN 5436); $KP_{1,2}$ lower (GN 5466) and middle (GN 5476).

Holotype: Pl. 13, fig. 26; 27 X 20 μm in size; exine tectate or intrabaculate, 0.5 μm thick, finely granulate to punctate on surface; width/length ratio=0.74; $KP_{1,2}$ middle (GN 5476).
Name dervation: From Anatolia district.
Remarks: This new species is similar to *Tricolpopollenites meinohamensis* Takahashi and *T. chikushiensis* Takahashi in morphological shape, but differs in having finely granulate to punctate sculptures on exine-surface and small baculate to tectate muri.
Botanical affinity: Unknown.

(105) *Tricolpopollenites asper* Pflug & Thomson
Pl. 14, figs. 8–13.

1953 *Tricolpopollenites asper* Pflug & Thomson, Thomson & Pflug, palaeontographica, B, 94, p. 96, pl. 11, figs. 43–49.

Description: See Pflug & Thomson in Thomson & Pflug (1953).
Dimensions: 25–33 μm X 23–32 μm in size; exine 0.5–1 μm thick; width/length ratio=1.0 or more.
Occurrence: $KM_{1,2}$ lower (GN 5401), middle (GN 5411), and upper (GN 5421); KM_3 Kisrakdere W. (GN 5451); $KP_{1,2}$ lower (GN 5466), middle (GN 5476), and upper (GN 5490).
Botanical affinity: Cupuliferae, probably *Quercus*.

(106) *Tricolpopollenites chagrenatus* Takahashi & Jux
Pl. 13, figs. 28–36.

1989 *Tricolpopollenites chagrenatus* Takahashi & Jux, Bull. Fac. Liberal Arts, Nagasaki Univ., Nat. Sci., vol. 29, no. 2, p. 407, pl. 11, figs. 13–15.

Description: See Takahashi & Jux (1989).
Dimensions: 21–29 μm X 17–23 μm in size; exine more or less chagrenate, 0.5–1 μm thick; width/length ratio=0.66–1.09.
Occurrence: $KM_{1,2}$ lower (GN 5401) and upper (GN 5421); KM_3 Kisrakdere W. (GN 5452); $KP_{1,2}$ upper (GN 5486, GN 5489).
Botanical affinity: Probably Cupuliferae.

(107) *Tricolpopollenites pseudoasper* Takahashi & Jux

Pl. 13, figs. 40–43.

1989 *Tricolpopollenites pseudoasper* Takahashi & Jux, Bull. Fac. Liberal Arts, Nagasaki Univ., Nat. Sci., vol. 29, no. 2, pp. 408–409, pl. 12, figs. 5–9.

Description: See Takahashi & Jux (1989).
Dimensions: 17–22 μm X 12–15 μm in size; exine chagrenate, 0.5–1 μm thick; width/length ratio=0.65–0.85.
Occurrence: KM $_{1,2}$ lower (GN 5401) and middle (GN 5412); KP $_{1,2}$ lower (GN 5466) and upper (GN 5486).
Botanical affinity: Probably Cupuliferae.

(108) *Tricolpopollenites robusteus* Song, Li & Zhong n. comb.
Pl. 14, fig. 14.

1986 *Quercoidites robusteus* Song, Li & Zhong, Palaeontologia Sinica, whole number 171, N. S. A, no. 10, p. 82, pl. 22, figs. 15, 16.

Description: See Song, Li & Zhong (1986).
Dimension: 45 X 35 μm in size; exine granulate to punctate, 1 μm thick on sides and 2 μm thick in polar areas; muri baculate-tectate; width/length ratio = 0.777.
Occurrence: KM $_{1,2}$ upper (GN 5421).
Botanical affinity: Unknown.

(109) *Tricolpopollenites* sp. a
Pl. 13, figs. 22. 44.

Description: Tricolpate pollen grains. Figura ellipsoidal or prolate in equatorial view. Three colpi conspicuous, arranged in radial symmetry and converging towards the apices. Exine finely granulate to punctate, 0.5–1 μm thick.
Dimensions: 19–22 μm X 10.5–15 μm in size; width/length ratio=0.552–0.681.
Occurrence: KM $_{1,2}$ upper (GN 5421); KP $_{1,2}$ lower (GN 5466).
Botanical affinity: Unknown.

(110) *Tricolpopollenites* sp. b
Pl. 21, fig. 17.

Descriptipn: Tricolpate pollen grain. Outline triangular in polar view. Three colpi conspicuous, relatively short, and gaped. Exine two-layered, 0.5 μm thick, punctate.
Dimensions: 23 μm in equatorial diameter.
Occurrence: KP $_{1,2}$ middle (GN 5476).
Botanical affinity: Unknown.

Tricolporate pollen:
Genus: *Compositoipollenites* Potonié 1951 ex Potonié 1960.
Type Species: *Compositoipollenites rhizophorus* (Potonié 1934) Potonié 1951.

(111) *Compositoipollenites denizliensis* Nakoman n. comb.
Pl. 18, figs. 14a–b.

1967 *Tricolporopollenites denizliensis* Nakoman, Bull. Min. Res. Explor. Inst. Turkey, no. 68, p. 37, pl. 1, fig. 27.

Description: See Nakoman (1967).
Dimensions: 58 X 50 μm (47 X 35 μm without sculpture) in size in polar view; spines 7–9 μm high.
Occurrence: KP $_{1,2}$ lower (GN 5466).
Remarks: Nakoman (1967) described newly *Tricolporopollenites denizliensis* Nakoman from Miocene sediments of Berdik (Denizli-Göktepe), SW Anatolia. Ths is large form (70–90 μm), but our single specimen is smaller, whereas both the specimens have very close similarity in general features and are the same species.
Tricolporopollenites denizliensis must be replaced by the genus *Compositoipollenites*.
Botanical affinity: Compositae-Carduoideae.

Genus: *Cupuliferoipollenites* Potonié 1951 ex Potonié 1960.
Type species: *Cupuliferoipollenites pusillus* (Potonié 1934) Potonié 1960.

(112) *Cupuliferoipollenites fusus* (Potonié) Takahashi & Jux
Pl. 17, figs. 7, 8.

1931 *Pollenites fusus* Potonié, Z. Braunkohle, H. 16, 30. Jrg., p. 332, pl. 1, fig. 13.
1934 *Pollenites cingulum* (Potonié) Thomson & Pflug *fusus* (Potonié) Potonié, Arb. Inst.

Paläobot. Petrogr. Brennst., 4, p. 82, pl. 4, fig. 20.
1982 *Cupuliferoipollenites fusus* (Potonié) Takahashi & Jux, Bull. Fac. Liberal Arts, Nagasaki Univ., Nat. Sci., vol. 23, no. 1, pp. 48–49, pl. 5, figs. 28–29.

Description: See Potonié (1931) and Takahashi & Jux (1982).
Dimensions: 24–30 μm X 13–17 μm in size; exine 1 μm thick; pores more or less lalongaste; windth/length ratio=0.541–0.566.
Occurrence: KM $_{1,2}$ lower (GN 5401); KP $_{1,2}$ middle (GN 5476).
Botanical affinity: Fagaceae, *Castanopsis* .

(113) *Cupuliferoipollenites pusillus* (Potonié) Potonié
Pl. 16, figs. 17–22.

1934 *Pollenites quisqualis pusillus* Potonié, Arb. Inst. Paläobot. Petrogr. Brennst., 4, p. 71, pl. 3, fig. 21.
1951 *Cupuliferoipollenites pusillus* Potonié, Palaeontographica, B, 91, pl. 20, fig. 69.
1960 *Cupuliferoipollenites pusillus* (Potonié) Potonié, Beih. Geol. Jb., 39, p. 98, pl. 6, fig. 111.

Description: See Potonié (1934, 1960).
Dimensions: 15–22 μm X 11–14 μm in size; exine laevigate, 0.5–1 μm thick; pores lalongate; width/length ratio=0.571–0.733.
Occurrence: KM $_{1,2}$ lower (GN 5402) and middle (GN 5412); KP $_{1,2}$ middle (GN 5476) and upper (GN 5488).
Botanical affinity: Fagaceae, *Castanea*. Besides, *Castanopsis*, *Lithocarpus* and *Pasania* are considered.

(114) *Cupuliferoipollenites* cf. *pusillus* (Potonié) Potonié
Pl. 16, fig. 24.

Dimensions: 20 X 16 μm in size; exine 0.5 μm thick, somewhat intrabaculate; pores lalongate; with/length ratio=0.8.
Occurrence: KP $_{1,2}$ middle (GN 5476).
Botanical affinity: Fagaceae, *Castanea*. Besides, *Castanopsis*, *Lithocarpus* and *Pasania* are considered.

(115) *Cupuliferoipollenites* sp.
Pl. 17, fig. 4.

Description: Tricolporate pollen grain. Amb long-elliptical or perprolate in equatorial view. Three colpi conspicuous and running parallel from pole to pole. Exine thin, laevigate, 0.6 μm thick; pores lalongate.
Dimensions: 29 X 11.5 μm in size; windth/length ratio=0.396.
Occurrence: KM $_{1,2}$ lower (GN 5401).
Botanical affinity: Unknown.

Genus: *Cyrillaceaepollenites* Mürriger & Pflug 1951 ex Potonié 1960.
Type species: *Cyrillaceaepollenites megaexactus* (Potonié 1931) Potonié 1960.

(116) *Cyrillaceaepollenites megaexactus* (Potonié) Potonié
Pl. 17, fig. 2.

1931 *Pollenites megaexactus* Potonié, Sitz. Ber. Ges. Nsturf. Fr., nos. 1−3, p. 26, pl. 1, V 24b.
1960 *Cyrillaceaepollenites* (al. *Pollenites*) *megaexactus* (Pot.) Potonié, Beih. Geol. Jb., 39, p. 102, pl. 6, fig. 115.

Description: See Potonié (1931, 1960).
Dimensions: 17 X 15 μm in size; exine weakly chagrenate, 0.5 μm thick; width /length ration=0.882.
Occurrnce: KP $_{1,2}$ upper (GN 5486).
Botanical affinity: Cyrillaceae; *Cyrilla, Cliftonia* or *Costaea*.

Genus: *Ilexpollenites* Thiergart 1937 ex Potonié 1960.
Type species: *Ilexpollenites iliacus* (Potonié 1931) Thiergart 1937 ex Potonié 1960.

(117) *Ilexpollenits margaritatus* (Potonié) Raatz, ex Potonié
Pl. 18, figs. 11−13.

1931 *Pollenites margaritatus* Potonié, Z. Braunkohle, H. 16, 30 Jrg., p. 328, pl. 1, figs. 32−33.
1937 *Ilex-pollenites margaritatus* Potonié, Raatz, Abh. Preuss. Geol. L. A., N. F., H. 183, pp. 25−26
1960 *Ilexpollenites* (al. *Pollenites*) *margaritatus* (Pot.) Raatz, Potonié, Beih. Geol. Jb., 39, pp. 99−100.

Description: See Potonié (1931) and Raatz (1937).

Dimensions: 28−33 μm X 22−22 μm in size in equatorial view; 29 X 27 μm in equatorial diameter in polar view; ornamentation clavate, 1−1.5 μm long; width/length ratio=0.636−0.786.
Occurrence: KP 1, 2 Lower (GN 5466) and middle (GN 5476).
Botanical affinity: Aquifoliaceae, *Ilex* .

(118) *Ilexpollenites tertiarius* (Takahashi) Takahashi
Pl. 18, figs. 5−10.

1961 *Tricolporopollenites tertiarius* Takahashi, Mem. Fac. Sci., Kyushu Univ., Ser. D, Geol., vol. 11, no. 3, p. 332, pl. 26, figs. 29−33.
1963 *Ilexpollenites tertiarius* (Takahashi) Takahashi, Mem. Fac. Sci., Kyushu Univ., Ser. D, Geol., vol. 14, no. 2, p. 150, pl. 21, fig. 18.

Description: See Takahashi (1961, 1963).
Dimensions: 22−28 μm X 18−25 μm in size in equatorial view; 18.5−26 μm in equatorial diameter in polar view; clavae 1−1.6 μm long; width/length ratio= 0.818−0.926.
Occurrence: KM 1, 2 lower (GN 5401) ; KM 3 Kisrakdere W. (GN 5451) ; KP 1, 2 lower (GN 5466) and middle (GN 5476).
Botanical affinity: Aquifoliaceae, *Ilex*.

Genus: *Intrabaculitricolporites* Kedves 1978.
Type species: *Intrabaculitricolporites porasper* (Pflug 1953) Kedves 1978.

(119) *Intrabaculitricolporites consularis* (Tskahashi) Takahashi & Jux *consularis*
Pl. 16, figs. 1−4, 12−16,

1961 *Tricolporopollenites consularis* Takahashi, Mem. Fac. Sci., Kyushu Univ., Ser. D, Geol., vol. 11, no. 3, p. 323, pl. 24, figs. 55−56 (p.p.).
1989 *Intrabaculitricolporites consularis* (Takahashi) Takahashi & Jux *consularis* , Takahashi & Jux, Bull. Fac. Liberal Arts, Nagasaki Univ., Nat. Sci., vol. 29, no. 2, pp. 234−235, pl. 29, figs. 4−5.

Description: See Takahashi (1961) and Takahashi & Jux (1989).
Dimensions: 25−36 μm X14.5−25 μm in size in equatorial view; exine intrabaculate, 0.5−1.5 μm thick (1.5 μm thick in polar areas); ectexine as thick as endexine; pores elongated more or less meridionally; width/length ratio =

0.58−0.735.
Occurrence: $KM_{1,2}$ lower (GN 5401); KM_3 Merkez Munja (GN 5437) and Kisrakdere W. (GN 5452); $KP_{1,2}$ lower (GN 5466) and middle (GN 5476).
Botanical affinity: ? Cupuliferae.

(120) *Intrabaculitricolporites* cf. *consularis* (Takahashi) Takahashi & Jux *consularis*
Pl. 16, fig. 23.

Dimensions: 20 X 12 μm in size; exine intrabaculate, 0.5 μm thick; width/length ratio=0.6.
Occurrence: KM_3 Merkez Munja (GN 5437).

(121) *Intrabauclitricolporites consularis* (Takahashi) Takahashi & Jux *globularis* (Takahashi) Takahashi & Jux
Pl. 16, figs. 5, 8.

1961 *Tricolporopollenites consularis* Takahashi, Mem. Fac. Sci., Kyushu Univ., Ser. D, Geol., vol. 11, no. 3, p. 323, pl. 24, figs. 53−54 (p.p.).
1989 *Intrabaculitricolporites consularis* (Takahashi) Takahashi & Jux *globularis* (Takahashi) Takahashi & Jux, Bull. Fac. Liberal Arts, Nagasaki Univ., Nat. Sci., vol. 29, no. 2, p. 235, pl. 28, figs. 14−16.

Description: See Takahashi (1961) and Takahashi & Jux (1989).
Dimensions: 28−33 μm X 22−27 μm in size; exine intrabaculate, 0.5 μm thick on sides and 1−1.5 μm thick in polar areas; width/length ratio=0.785−0.818.
Occurrence: $KP_{1,2}$ middle (GN 5476).
Botanical affinity: ? Cupuliferae.

(122) *Intrabaculitricolporites ellipsoideus* Takahashi & Jux n. comb.
Pl. 17, fig. 3.

1986 *Tricolporopollenites ellipsoideus* Takahashi & Jux, Bull. Fac. Liberal Arts, Nagasaki Univ., Nat. Sci., vol. 26, no. 2, p. 153, pl. 24, figs. 14−24; pl. 25, fig. 5 (cf,),

Description: See Takahashi & Jux (1986).
Dimensions: 27−32 μm X 12−24 μm in size; exine intrabaculate, 0.5 μm thick on sides and 1 μm thick in polar areas; pores elongated meridionally; width /length ratio=0.444−0.75.

Occurrence: KM 3 Kisrakdere W. (GN 5451); KP 1, 2 middle (GN 5476) and upper (GN 5486).
Botanical affinity: Unknown.

(123) *Intrabaculitricolporites* sp. a
Pl. 17, figs. 1.

Description: Tricolporate pollen grain. Figura broad-ellipsoidal or subprolate in equatorial view. Three colpi prominent and converging at the apices. Equatorial pores somewhat lalongate or round. Exine two-layered, intrabaculate, 1−1.2 μm thick.
Dimensions: 10−28 μm X 16−22 μm in size; width/length ratio=0.785−0.842.
Occurrence: KM 3 Merkez Munja (GN 5436); KP 1, 2 middle (GN 5476).
Botanical affinity: Unknown.

(124) *Intrabaculitricolporites*: sp. b
Pl. 17, figs. 5, 6, 9.

Description: Tricolporate pollen grains. Amb long-elliptical or perprolate in equatorial view. Three colpi conspicuous, running parallel towards the poles, and converging at the poles. Exine chagrenate, intrabaculate in polar areas, 0.5−1 μm thick; ectexine thicker than endexine; equatorial pores small and round.
Dimensions: 30−32 μm X 12−16 μm in size; width/lngth ratio=0.4−0.5.
Occurrence: KM 1, 2 lower (GN 5401); KP 1, 2 lower (GN 5466).
Botanical affinity: Unknown.

Genus: *Nyssapollenites* Thiergart 1937 ex Potonié 1960.
Type species: *Nyssapollenites pseudocruciatus* (Potonié 1931) Thiergart 1937.

(125) *Nyssapollenites kruschi* (Potonié) Nagy
Pl. 16, figs. 6, 7, 9−11.

1931 *Pollenites kruschi* Potonié, Jb Preuss. Geol. L. A. f., vol. 52, p. 4, fig. 11.
1953 *Tricolporopollenites kruschi* (R. Pot.) Thomson & Pflug, Palaeontographica, B, 94, p. 103.
1966 *Nyssapollenites kruschi* (Potonié) Nagy, Ann. Hung. Geol. Inst., vol. 52, Fasc. 2, p. 409.

Descriptipn: See Potonié (1931) and Thomson & Pflug (1953).
Dimensions: 30−32 μm X 26−27 μm in size; exine intrabaculate, 0.5 μm thick on sides and 1−1.7 μm thick in polar areas; equatorial pores large and round; width/length ratio=0.843−0.866.
Occurrence: KP $_{1,2}$ middle (GN 5476) and upper (GN 5486).
Botanical affinity: Nyssaceae, *Nyssa* .

(126) *Nyssapollenites Kruschi* (Potpnié) Nagy asp. *pseudolaesus* (Potonié) n. comb.
Pl. 16, figs. 25a−b.

1953 *Tricolporopollenites kruschi* (R. Pot.) Thomson & Pflug asp. *pseudolaesus* (R. Pot.) Thomson & Pflug, Palaeontographica, B, 94, p. 104, pl. 13, figs. 47−63.

Description: See Thomson & Pflug (1953).
Dimensions: 21 μm in equatorial diameter.
Occurrence: KP $_{1,2}$ lower (GN 5466).
Botanical affinity: Nyssaceae, *Nyssa* .

Genus: *Rhoipites* Wodehose 1933.
Type species: *Rhoipites bradleyi* Wodehouse 1933.

(127) *Rhoipites* cf. *bradleyi* Wodehouse
Pl. 18, fig. 4.

1933 *Rhoipites bradleyi* Wodehouse, Bull. Torr. Bot. Club, vol. 60, p. 513, fig. 45.

Description: See Wodehouse (1933).
Dimensions: 29 X 19 μm in size; lumina of reticulum less than 0.5 μm in diameter; muri baculate-tectate, 1 μm high; width/length ratio=0.655.
Occurrence: KP $_{1,2}$ lower (GN 5466).
Botanical affinity: Anacardiaceae, *Rhus*.

(128) *Rhoipites finitus* (Guzmán) Takahashi & Jux
Pl. 17, fig. 24.

1967 *Retitricolporites finitus* González Guzmán, E. J. Brill, Leiden, p. 40, pl. 10, figs. 4−4b.

1989 *Rhoipites* cf. *finitus* (González Guzmán) Takahashi & Jux, Bull. Fac. Liberal Arts, Nagasaki Univ., Nat. Sci., vol. 29, no. 2, p. 244, pl. 29, fig. 25; pl. 30, fig. 7.

Description: See González Guzmán (1967) and Takahashi & Jux (1989).
Dimensions: 27 X 18 μm in size; lumina of reticulum less than 1 μm in diameter; muri baculate-tectate, 0.5 μm high on sides, 0.8 μm high in polar areas; width/length ratio=0.666.
Occurrence: KP $_{1,2}$ middle (GN 5477).
Botanical affinity: Caprifoliaceae, *Viburnum*.

(129) *Rhoipites minus* Takahashi & Jux
Pl. 17, figs. 21, 22.

1986 *Rhoipites minus* Takahashi & Jux, Bull. Fac. Liberal Arts, Nagasaki Univ., Nat. Sci., vol. 26, no. 2, pp. 163–164, pl. 26, figs. 5–11.

Description: See Takahashi & Jux (1986).
Dimensions: 12–16 μm X 12–14 μm in size; exine very finely reticulate; muri finely baculate; width/length ratio=0.75–1.16.
Occurrence: KM $_{1,2}$ lower (GN 5401).
Botanical affinity: Unknown.

(130) *Rhoipites mirus* Takahashi & Jux
Pl. 17, fig. 23.

1982 *Rhoipites mirus* Takahashi & Jux, Bull. Fac. Liberal Arts, Nagasaki Univ., Nat. Sci., vol. 23, no. 1, pp. 53–54, pl. 6, figs. 11–12.

Description: See Takahashi & Jux (1982).
Dimensions: 24 X 15 μm in size; exine finely reticulate; lumina of reticulum less than 0.5 μm in diameter; muri baculate-tectate; width/length ratio=0.625.
Occurrence: KP $_{1,2}$ middle (GN 5476).
Botanical affinity: Unknown.

(131) *Rhoipites retiformis* Rocknall & Mildenhall
Pl. 18, fig. 3.

1984 *Rhoipites retiformis* Rocknall & Mildenhall, N. Z. G. S., Palaeont. Bull., 51, p. 36, pl. 17, figs. 1–5.

Description: See Rocknall & Mildenhall (1984).
Dimensions: 28 X 22 μm in size; exine finely reticulate; muri finely baculate-tectate; width/length ratio=0.785.
Occurrence: KM $_{1,2}$ lower (GN 5401).
Botanical affinity: Anacardiaceae, *Rhus*.

(132) *Rhoipites rotundus* Takahashi & Jux
Pl. 18, fig. 2.

1989 *Rhoipites rotundus* Takahashi & Jux, Bull. Fac. Liberal Arts, Nagasaki Univ., Nat. Sci., vol. 29, no. 2, p. 420, pl. 13, figs. 15–22.

Description: See Takahashi & Jux (1989).
Dimensions: 21 X 21 μm in equatorial diameter; lumina of reticulum less than 3.5 μm in diameter; muri baculate to clavate, 1 μm high; pores large and round.
Occurrence: KM $_{1,2}$ middle (GN 5412).
Botanical affinity: Celastraceae, *Celastrus* .

(133) *Rhoipites* sp. a
Pl. 17, fig. 25.

Description: Tricolporate pollen grain. Figura ellipsoidal or prolate with hemispherical pole in equatorial view. Three slender colpi narrow, radially symmetrical, and converging to the poles. Exine very finely reticulate; lumina of reticulum less than 0.5 μm in diamter; muri baculate-partially tectate, 0.5 μm high.
Dimensions: 31 X 23 μm in size; width/length ratio=0.741.
Occurrence: KP $_{1,2}$ upper (GN 5488).
Remarks: It appeared to be unreasonable to identify the single specimen specifically.
Botanical affinity: Unknown.

(134) *Rhoipites* sp. b
Pl. 18, fig. 1.

Description: Tricolporate pollen grain. Outline circular in somewhat oblique view. Three colpi conspicuous, radially symmetrical, and converging towards

the poles. Exine very finely reticulate; lumina of reticulum less than 0.5 μm in diameter; muri tectate or intrabaculate, 1 μm thick.
Dimensions: 23 X 22 μm in approx. equatorial diameter.
Occurrence: $KM_{1,2}$ lower (GN 5401).
Botanical affinity: Unknown.

Genus: *Striatocolporites* Ramanujam 1966.
Type species: *Striatocolporites grandis* Ramanujam 1966.

(135) *Striatocolporites ovuliformis* Takahashi & Jux
Pl. 17, figs. 20a–b.

1989 *Striatocolporites ovuliformis* Takahashi & Jux, Bull. Fac. Liberal Arts, Nagasaki Univ., Nat. Sci., vol. 29, no. 2, p. 241, pl. 25, figs. 2–7; pl. 36, figs. 1–3.

Description: See Takahashi & Jux (1989).
Dimensions: 46 X 38 μm in equatorial diameter; muri baculate, 0.5–3 μm high.
Occurrence: $KP_{1,2}$ middle (GN 5476).
Botanical affinity: Leguminosae (*Bauhinia*) or Gentianaceae (*Grawfurdia, Gentiana*).

(136) *Striatocolporites* sp. a
Pl. 17, fig. 18.

Description: Tricolporate pollen grain. Figura ellipsoidal or prolate in equatorial view. Three colpi conspicuous, radially symmetrical, and converging towards the poles. Exine two-layered, weakly striated, 1 μm thick. Equatorial pores elongated meridionally.
Dimensions: 35.5 X 25 μm in size; width/length ratio=0.704.
Occurrence: $KP_{1,2}$ upper (GN 5487).
Remarks: Only one specimen was observed. This possesses three pores elongated meridionally, whereas *S. striatulus* has somewhat lalongated pores.
Botanical affinity: Unknown.

(137) *Striatocolporites* sp. b
Pl. 17, fig. 19.

Description: Tricolporate pollen grain. Figura globular or spherical in oblique view. Three colpi conspicuous, radially symmetrical, gaped, and converging towards the poles. Exine finely striated; muri baculate-tectate, 1.5 μm high.

Dimensions: 37 μm in diameter.

Occurrence: $KM_{1,2}$ upper (GN 5421).

Remarks: A single specimen observed cannot be given its specific epithet.

Botanical affinity: Unknown.

Genus: *Tricolporopollenites* Pflug & Thomsom 1953.

Type species: *Tricolporopollenites dolium* (Potonié 1931) Thomson & Pflug 1953.

(138) *Tricolporopollenites pseudochagrenatus* Takahashi & Jux
Pl. 17, fig. 13.

1986 *Tricolporopollenites pseudochagrenatus* Takahashi & Jux, Bull. Fac. Liberal Arts, Nagasaki Univ., Nat. Sci., vol. 26, no. 2, pp. 154–155, pl. 24, figs. 28–30; pl. 27, fig. 20.

Description: See Takahashi & Jux (1986).

Dimensions: 19 X 13 μm in size; exine somewhat chagrenate, 0.5 μm thick; width/length ratio=0.684.

Occurrence: $KP_{1,2}$ upper (GN 5488).

Botanical affinity: ? Cupuliferae.

(139) *Tricolporopollenites turcianus* n. sp.
Pl. 16, figs. 26–29.

Description: Tricolporate pollen grains. Amb elliptical or prolate to subprolate in equatorial view. Three colpi strong, conspicuous, running parallel to the poles or converging towards the poles. Exine three-layered; endexine smooth; outer exctexine smooth and inner one intrabaculate; 0.5–1 μm thick on the sides and 2–2.2 μm thick in the apocolpia. Equatorial pores lalongate.

Dimensions: 29–37 μm X 20–24 μm in size; width/length ratio=0.621–0.827.

Occurrence: $KP_{1,2}$ middle (GN 5476, GN 5477) and upper (GN 5488).

Holotype: Pl. 16, fig. 26; 37 X 23 μm in size; exine three-layered, 1 μm thick on the sides and 2.2 μm thcik in the apocolpia; outer ectexine smooth and inner one intrabaculate; endexine smooth; width/length ratio=0.621; $KP_{1,2}$ mid-

dle (GN 5477).
Name derivation: From the Republic of Turkey.
Comparison: The new pollen grains do not compare with any of the fossil species of the genus *Tricolporopollenites*. Accordingly, the authors have named a new specific epithet to them.
Botanical affinity: ? Fagaceae.

(140) *Tricolporopollenites* cf. *turcianus* n. sp.
Pl. 17, fig. 11.

Dimensions: 25 X 27 μm in size; exine three-layered; 2 μm thick; pores lalongate; width/length ratio=1.08.
Occurrence: KP $_{1,2}$ middle (GN 5476).

(141) *Tricolporopollenites* sp. a
Pl. 17, fug. 10.

Description: Tricolporate pollen grain. Outline broad-elliptical or subprolate in equatorial view. Three colpi conspicuous, radially symmetrical, and converging at the apices. Exine two-layered, chagrenate, 1 μm thick. Equatorial pores lalongate.
Dimensions: 28 X μm in size; width/length ratio=0.785.
Occurrence: KP $_{1,2}$ middle (GN 5476).
Botanical affinity: Unknown.

(142) *Tricolporopollenites* sp. b
Pl. 17, fig. 12.

Description: Tricolporate pollen grain. Amb elliptical or prolate in equatorial view. Three colpi conspicuous, radially symmetrical, and converging towards the poles. Exine two-layered, chagrenate, 1 μm thick. Equatorial pores elongated more or less meridionally.
Dimensions: 36 X 26 μm in size; width/length ratio=0.722.
Occurrence: KM $_{1,2}$ upper (GN 5422).
Botanical affinity: Unknown.

(143) *Tricolporopollenites* sp. c
Pl. 17, fig. 14.

Description: Tricolporate pollen grain. Amb elliptical or subprolate in equatorial view. Three colpi not always visible due to baculate sculpture, running parallel towards the poles. Exine baculate; bacula 3.5 μm long. Pores elongated meridionally (?).
Dimensions: 28 X 22 μm in size; width/length ratio=0.785.
Occurrence: KM $_{1,2}$ lower (GN 5401).
Comparison: *Tricolporopollenites baculoferus* Pflug (1953) with densely distributed bacula is larger in size than the present specimen with longer bacula.
Botanical affinity: Unknown.

(144) *Tricolporopollenites* sp. d
Pl. 17, fig. 15.

Description: Tricolporate pollen grain with elliptical or prolate contour in equatorial view. Three colpi radially symmetrical and converging to the poles. Exine finely granulate to baculate; bacula 1 μm long. Equatorisl pores elongated somewhat meridionally.
Dimensions: 33 X 19 μm in size; width/length ratio=0.575.
Occurrence: KP $_{1,2}$ lower (GN 5466).
Botanical affinity: Unknown.

(145) *Tricolporopollenites* sp. e
Pl. 17, fig. 16.

Description: Tricolporate pollen grain. Contour circular in oblique view. Three colpi conspicuous, arranged in radial symmetry, and converging near the poles. Exine punctate. Equatorial pores small and round.
Dimensions: 32 X 32 μm in diameter.
Occurrence: KP $_{1,2}$ middle (GN 5476).
Botanical affinity: Unknown.

(146) *Tricolporopollenites* sp. f
Pl. 17, fig. 17.

Description: Tricolporate pollen grain. Amb circular or spherical in equatorial view. Three colpi narrow, arranged in radial symmetry, and converging at the apices. Exine thin, 0.5 μm thick, and finely punctate to chagrenate. Equatorial pores elongated meridionally.

Dimensions: 27 X 25 μm in size; width/length ratio=0.925.
Occurrence: KP 1, 2 Upper (GN 5486).
Botanical affinity: Unknown.

Triporate pollen:
Genus: *Betulaepollenites* Potonié 1934 ex Potonié 1960.
Type species: *Betulaepollenites microexcelsus* (Potonié 1931) Potonié 1934

(147) *Betulaepollenites* sp.
Pl. 21, figs. 1, 2.

Description: Triporate, lenticular pollen grains. Equatorial contour triangular with rounded-convex sides. Three germinals round to slightly lolongate, with a distinct annulus (5.5 μm in diameter), and interconnected by arci; one pore situated equatorially, 2 μm in diameter. Exine, 0.5 μm thick, chagrenate to punctate.
Dimensions: 30 μm in diameter.
Occurrence: KM 1, 2 upper (GN 5421); KP 1, 2 lower (GN 5466).
Botanical affinity: Betulaceae, *Betula.*

Genus: *Caryapollenites* Raatz 1937 ex Potonié 1960.
Type species: *Caryapollenites simplex* (Potonié 1931) Raatz 1937 *simplex* .

(148) *Caryapollenites simplex* (Potonié) Raatz *simplex*
Pl. 21, figs. 12–14.

1931 *Pollenites simplex* Potonié, Jb. Preuss. Geol. L. A. f., vol. 52, p. 2, fig. 4.
1937 *Carya-pollenites simplex* R. Pot. f. *communis* Raatz, Abh. Preuss. Geol. L. A., N.F., 183, p. 19, fig. 6.
1960 *Caryapollenites simplex* (R. Pot. 1931) Raatz 1937, Potonié, Beih. Geol. Jb., 39, p. 123.

Description: See potonié (1931, 1960) and Raatz (1937).
Dimensions: 43–50 μm in equatorial diameter; exine 1.2 – 2.2 μm thick, finely punctate.
Occurrence: KM 1, 2 lower (GN 5401) and upper (GN 5421); KM 3 Merkez Munja (GN 5436) and Kisrakdere W. (GN 5454); KP 1, 2 lower (GN 5466) and upper (GN 5488).

Botanical affinity: Juglandaceae, *Carya*.

Genus: *Engelhardtioidites* Potonié, Thomson & Thiergart 1950 ex Potonié 1960.
Type species: *Engelhardtioidites microcoryphaeus* (Potonié, 1931) Potonié, Thomson & Thiergart 1950 ex Potonié 1960.

(149) *Engelhardtioidites microcoryphaeus* (Potonié) Potonié, Thomson & Thiergart ex Potonié
Pl. 20, figs. 8, 9.

1931 *Pollenites microcoryphaeus* Potonié, Z. Braunkohle, H. 16, 30. Jrg., p. 329, pl. 2, fig. 13.
1950 *Engelhardtioidites microcoryphaeus* (R. Pot. 1931) Pot., Thoms. & Thierg., Geol. Jb., 65, p. 51, pl. B, fig. 8; pl. C, fig. 16.
1960 *Engelhardtioidites microcoryphaeus* (R. Pot. 1931) Pot., Thoms. & Thierg. 1950, Beih Geol. Jb., 39, p. 118, pl. 7, figs. 148–149.

Description: See Potonié (1931, 1960).
Dimensions: 20–24 μm in diameter; exine 1 μm thick.
Occurrence: $KM_{1,2}$ lower (GN 5401), middle (GN 5411), and upper (GN 5422); KM_3 Merkez Munja (GN 5436, GN 5437) and Kisrakdere W. (GN 5451, GN 5454); $KP_{1,2}$ Lower (GN 5466), middle (GN 5476), and upper (GN 5486).
Botanical affinity: Juglandaceae, *Engelhardtia*.

Genus: *Engelhardtioipollenites* Potonié 1951 ex Potonié 1966.
Type species: *Engelhardtioipollenites punctatus* (Potonié 1931) Potonié 1951 ex Potonié 1960.

(150) *Engelhardtioipollenites punctatus* (Potonié) Potonié ex Potonié
Pl. 19, fig. 17; pl. 20, figs. 1–6.

1931 *Pollenites coryphaeus* forma *punctatus* Potonié, Z. Braunkohle, H. 16, 30. Jrg., p. 329, pl. 2, figs. 7, 11.
1951 *Engelhardtioipoll. punctatus* R. Pot., Palaeontographica, B, 91, pl. 20, fig. 34.
1960 *Engelhardtioipollenites* (al. *Pollenites*) *punctatus* (Pot. 1931) Potonié, Beih. Geol. Jb., p. 117, pl. 7, fig. 147.

Description: See Potonié (1931, 1960).
Dimensions: 26–30 μm in equatorial diameter; exine 0.5–1.5 μm thick.

Occurrence: $KP_{1,2}$ lower (GN 5401) and upper (GN 5421); KM_3 Kisrakdere W. (GN 5452); $KP_{1,2}$ lower (GN 5466) and middle (GN 5476).
Botanical affinity: Juglandaceae, *Engelhardtia*.

Genus: *Momipites* Wodehouse 1933.
Type species: *Momipites coryloides* Wodehouse 1933.

(151) *Momipites somaensis* n. sp.
Pl. 20, figs. 14, 15, 20.

Description: Triporate pollen grains. Amb rounded-triangular with convex sides and rounded corners in polar view. Three pores round, moderately large, with weak annulus, and somewhat meridionally elliptical; two pores on the equator and one on the subequator. Exine 1–1.5 μm thick, chagrenate.
Dimensions: 27–34 μm in equatorial diameter
Occurrence: $KM_{1,2}$ lower (GN 5401); KM_3 Kisrakdere W. (GN 5451, GN 5452); $KP_{1,2}$ upper (GN 5486).
Holotype: Pl. 20, fig. 20; 33 μm in equatorial dimeter; exine 1.5 μm thick; pores with weak annulus and no labrum; one pore situated subequatorially; KM_3 Kisrakdere W. (GN 5452).
Name derivation: From Soma city.
Comparisons: The new species, *Momipites somaensis* , is closely similar to *M. coryloides* Wodehouse (1933) and *M. constatus* (Takahashi 1961) Takahashi, but differs from *M. coryloides* in having thicker exine and one pore situated subequatorially and from *M. constatus* in possessing thicker exine and weak annulus around the pores.
Botanical affinity: Betulaceae.

(152) *Momipites* sp.
Pl. 20, fig. 21.

Description: Triangular, triporate pollen grain with convex sides and three pores on the corners in polar view. Three pores small, situated on the equatorial corners, without annulus and labrum. Exine thin, finely punctate to chagrenate.
Dimensions: 25 μm in equatorial diameter.
Occurrence: KM_3 Merkez Munja (GN 5436).
Botanical affinity: Betulaceae.

Genus: *Subtriporopollenites* Pflug & Thomson 1953.
Type species: *Subtriporopollenites anulatus* Pflug & Thomson 1953 subsp. *anulatus*.

(153) *Subtriporopollenites kyushuensis* Takahashi
Pl. 20, figs. 22, 23; pl. 21, figs. 4–7.

1961 *Subtriporopollenites kyushuensis* Takahashi, Mem. Fac. Sci., Kyushu Univ., Ser. D, Geol., vol. 11, no.3, pp. 305–306, pl. 20, figs. 35–37; pl. 21, figs. 1–10.

Description: See Takahashi (1961).
Dimensions: 26–40 μm in equatorial dimeter; exine 0.5–1.5 μm thick.
Occurrence: $KM_{1,2}$ lower (GN 5402) and upper (GN 5421); KM_3 Merkez Munja (GN 5436) and Kisrakdere W. (GN 5452); $KP_{1,2}$ lower (GN 5466), middle (GN 5476), and upper (GN 5486).
Botanical affinity: Juglandaceae.

Genus: *Tiliaepollenites* Potonié 1931.
Type species: *Tiliaepollenites indubitabilis* Potonié (1931).

(154) *Tiliaepollenites instructus* Potonié ex Potonié & Venitz
Pl. 21, figs. 8–11.

1931 *Tiliae-pollenites instructus* Potonié, Z. Braunkohle, H, 27, 30. Jrg., p. 556, fig. 9.
1934 *Tiliaepollenites instructus* (R. Pot.1931) Potonié & Venitz, Arb. Inst. Paläobot. Petrogr. Brennst., Preuss. Geol. L. A., vol. 5, p. 37, pl. 4, fig. 109.

Description: See Potonié (1931) and Potonié & Venitz (1934).
Dimensions: 34–43 μm in equatorial diameter; exine 0.7–1 μm thick.
Occurrence: $KM_{1,2}$ lower (GN 5401) and middle (GN 5411).
Botanical affinity: Tiliacecae, *Tilia* .

Genus: *Triatriopollenites* Pflug 1953.
Type species: *Triatriopollenites rurensis* Pflug & Thomson 1953.

(155) *Triatriopollenites pseudorurensis* Pflug
Pl. 19, figs. 8, 9.

1953 *Triatriopollenites pseudorurensis* Pflug, Thomson & Pflug, Palaeontographica, B, 94, pp. 78–79, pl. 7, figs. 76–80.

Description: See Pflug in Thomson & Pflug (1953).
Dimensions: 29–34 μm in equatorial diameter; exine thin, chagrenate.
Occurrence: $KM_{1,2}$ lower (GN 5401), middle (GN 5412), and upper (GN 5421).
Botanical affinity: Myricaceae, *Myrica*.

(156) *Triatriopollenites rurensis* Pflug & Thomson
Pl. 19, figs. 4–7.

1953 *Triatriopollenites rurensis* Pflug & Thomson, Thomson & Pflug, Palaeontographica, B, 94, p. 79, pl. 7, figs. 81–109.

Description: See Pflug & Thomson in Thomson & Pflug (1953).
Dimensions: 27–36 μm in equatorial diameter; exine 0.6–1 μm thick in middle parts between pores.
Occurrence: $KM_{1,2}$ lower (GN 5401); KM_3 Merkez Munja (GN 5436); $KP_{1,2}$ lower (GN 5466), middle (GN 5476), and upper (GN 5486).
Botanical affinity: Myricaceae, *Myrica*.

(157) *Triatriopollenites* sp.
Pl. 19, fig. 16.

Description: Triporate pollen grain. Amb triangular with convex sides and rounded corners. Three pores situated on each corner, with atrium and without annulus and labrum. Exine tow-layered, 2 μm thick, chagrenate; ectexine as thick as endexine.
Dimensions: 27 μm in equatorial diameter.
Occurrence: KM_3 Merkez Munja (GN 5436); $KP_{1,2}$ lower (GN 5466).
Botanical affinity: Myricaceae.

Genus: *Triporopollenites* Pflug & Thomson 1953.
Type species: *Triporopollenites coryloides* Pflug 1953.

(158) *Triporopollenites shimensis* Takahashi
Pl. 20, higs. 11, 12.

1961 *Triporopollenites shimensis* Takahashi, Men. Fac. Sci., Kyushu Univ., Ser. D, Geol., vol. 11, no. 3, pp. 301–302, pl. 20, figs. 5–14.

Description: See Takahashi (1961).
Dimensions: 27–32 μm in diameter; exine 1 μm thick; one pore situated sub-equatorially.
Occurrence: $KM_{1,2}$ upper (GN 5402); KM_3 Kisrakdere W. (GN 5452); $KP_{1,2}$ lower (WN 5466) and middle (GN 5476).
Botanical affinity: Betulaceae.

(159) *Triporopollenites moderatus* n. sp.
Pl. 20, figs. 16–19.

Description: Triporate pollen grains. Amb triangular with convex sides in polar view. Three pores situated in each corner, more pr less larger (4.5 μm in diameter), with weak annulus and weak or no labrum. Exine two-layered, 0.5–1 μm thick, chagrenate.
Dimensions: 27–35 μm in equatorial diameter.
Occurrence: $KM_{1,2}$ lower (GN 5401): KM_3 Merkez Munja (GN 5437) and Kisrakdere W. (GN 5451).
Holotype: Pl. 20, fig. 16; 30 μm in diameter; exine 0.5 μm in middle part between pores, chagrenate; pores with week annulus and labrum; $KM_{1,2}$ lower (GN 5401).
Name derivation: *moderatus* (lat.)=moderate, temperate.
Comparisons: *Triporopollenites moderatus* n. sp. shows some similarity in form of *Triporopollenites festatus* Takahashi (1961), but differs in structures of the exine.
Botanical affinity: Betulaceae.

(160) *Triporopollenites subfragilis* Takahashi & Jux
Pl. 19, figs. 10–15; pl. 20, figs. 7, 10.

1986 *Triporopollenites subfragilis* Takahashi & Jux, Bull. Fac. Liberal Arts, Nagasaki Univ., Nat. Sci., vol. 26, no. 2, p. 188, pl. 28, figs. 16–19.

Description: See Takahashi & Jux (1986).
Dimensions: 21–37 μm in diameter; exine 0.5–1.2 μm thick; pores 4–6 μm wide in diameter.

Occurrence: $KM_{1,2}$ lower (GN 5401) and upper (GN 5421); KM_3 Merkez Munja (GN 5436) and Kisrakdere W. (GN 5451); $KP_{1,2}$ lower (GN 5466) and upper (GN 5486).
Botanical affinity: Unknown.

(161) *Triporopollenites* sp.
Pl. 20, fig. 13.

Description: Triporate pollen grain. Amb rounded-triangular with convex sides in polar view. Three pores small, situated in each corner, and without annulus and labrum. Exine thin, chagrenate.
Dimensions: 25 μm in equatorial diameter.
Occurrence: KM_3 Merkez Munja (GN 5437).
Remarks: A single specimen observed shows some similarity in form of pollen of *Engelhardtioidites microyphaeus* .
Botanical affinity: Juglandaceae, ? *Engelhardtia.*

Genus: *Trivestibulopollenites* Pflug 1953.
Type species: *Trivestibulopollenites betuloides* Pflug 1953.

(162) *Trivestibulopollenites betuloides* Pflug
Pl. 21, fig. 3.

1953 *Trivestibulopollenites betuloides* Pflug, Thomson & Pflug, Palaeontographica, B, 94, p. 85, pl. 9, figs. 25–34.

Description: See Pflug in Thomson & Pflug (1953).
Dimensions: 23 μm in equatorial diameter; exine 0.5 μm thick.
Occurrence: $KM_{1,2}$ upper (GN 5423).
Botanical affinity: Betulaceae, *Betula.*

Incertae sedis:
Genus: *Monogemmites* Krutzsch 1970.
Type species: *Monogemmites gemmatus* (Couper 1960) Krutzsch 1970.

(163) *Monogemmites pseudosetarius* (Weyland & Pflug) Krutzsch
Pl. 3, figs. 8–13.

1957 *Inaperturopollenites pseudosetarius* Weyland & Pflug, Palaeontographica, B, 102, p. 103, pl. 22, figs. 29–31.
1970 *Monogemmites pseudosetarius* (Weyland & Pflug) Krutzsch, Atlas. Lfg. VI, p. 146, pl. 39, figs. 21–25 (p.p.).

Description: See Weyland & Pflug (1957) and Krutzsch (1970).
Dimensions: 28–32 μm in diameter; exine 0.5–2 μm thick; spines 2–2.5 μm long.
Occurrence: KM_3 Kisrakdere W. (GN 5452, GN 5453, GN 5454) ; $KP_{1,2}$ middle (GN 5476).
Botanical affinity: Cyst of freshwater-phytoplankton.

Genus: *Ovoidites* Potonié 1951 emend. Potonié 1966.
Type species: *Ovoidites ligneolus* (Potonié 1931) Potonié 1951.

(164) *Ovoidites lanceolatus* n. sp.
Pl. 23, figs. 1, 2.

Description: Long spindle-shape with both truncated or obtuse ends (or apices) in outline. Wall thin, laevigate, and gaped like a colpus equatorially.
Dimensions: 51–55 μm in length and 23–34 μm in width; width/length ratio= 0.453–0.618.
Occurrence: KM_3 Merkez Munja (GN 5437) and Kisrakdere W. (GN 5452); $KP_{1,2}$ lower (GN 5466), middle (GN 5476), and upper (GN 5486).
Holotype: Pl. 23, fig. 1; 53 X 24 μm in size; exine thin, laevigate; width/length ratio=0.453; KM_3 Merkez Munja (GN 5437).
Name derivation: *lanceolatus* (lat.)=lanceolate, lanceolated.
Comparisons: The present specimens are superficially similar to *Schizosporis laevigatus* Stanley (1965) from Cannonball Member of the Fort Union Formation, South Dakota (U. S. A.), but differ in being much smaller in size.
Botanical affinity: Unknown.

(165) *Ovoidites pseudoligneolus* Krutzsch
Pl. 23, figs. 6–8.

1953 *Ovoidites ligneolus* R. Pot., Thomson & Pflug, Palaeontographica, B, 94, p. 113, pl. 15, fig. 100.
1959 *Ovoidites pseudoligneolus* Krutzsch, Geologie, Jrg. 8, Beih. 21/22, p. 252.

Description: See Thomson & Pflug (1953) and Krutzsch (1959).
Dimensions: 80−115 μm in length and 30−61 μm in width; exine 2 μm thick; width/length ratio=0.368−0.53.
Occurrence: KM_3 Kisrakdere W. (GN 5452); $KP_{1,2}$ lower (GN 5466, GN 5467, GN 5468).
Botanical affinity: Unknown.

(166) *Ovoidites raatzi* Nakoman
Pl. 23, fig. 5.

1966 *Ovoidites raatzi* Nakoman, Ann. Soc. Geol. Nord, vol. 86, pp. 92−93, pl. 11, fig. 24.

Descritpion: See Nakoman (1966).
Dimensions: 110 X 67 μm in size; exine 2 μm thick; width/length ratio=0.609.
Occurrence: $KP_{1,2}$ lower (GN 5467).
Botanical affinity: Unknown.

Genus: *Schizosporis* Cookson & Dettmann 1959 emend. Takahashi & Jux 1982.
Type species: *Schizosporis reticulatus* Cookson & Dettmann 1959.

(167) *Schizosporis cooksoni* Pocock
Pl. 23, fig. 3.

1962 *Schizosporis cooksoni* Pocock, Palaeontographica, B, 111, p. 76, pl. 13, figs. 197, 198.

Description: See Pocock (1962).
Dimensions: 47 X 32 μm in size; exine thin; width/length ratio=0.68.
Occurrence: $KP_{1,2}$ upper (GN 5487).
Botanical affinity: Unknown.

(168) *Schizosporis ellipsoideus* n. sp.
Pl. 23, figs. 9, 10.

Description: Spore fusiform or broad-elliptical in outline, fairly sharp at the ends, comprising two boat or elongate sections joined equatorially. Exine thin, less than 1 μm thick, smooth.

Dimensions: 61−73 μm in length and 35−43 μm in width; width/length ratio= 0.515−0.705.
Occurrence: KM_3 Kisrakdere W. (GN 5452); $KP_{1,2}$ lower (GN 5468), middle (GN 5476), and upper (GN 5488).
Holotype: Pl. 23, fig. 10; 61 X 43 μm in size; exine thin, smooth; width/length ratio=0.705; $KP_{1,2}$ upper (GN 5488).
Name derivation: *ellipsoideus* (lat.)=ellipsoidal.
Comparisons: Superficially the present grains are comparable with *Schizosporis cooksoni* Pocock, *S. grandis* Pocock, *S. parvus* Cookson & Dettmann, and *S. spriggi* Cookson & Dettmann, but appear to differ from them in form and size of the grains.
Botanical affinity: Unknown.

(169) *Schizosporis* cf. *parvus* Cookson & Dettmann
Pl. 23, fig. 4.

1959 *Schizosporis parvus* Cookson & Dettmann, Micropaleontology, vol. 5, no. 2, p. 216, pl. 1, figs. 15−20.
1966 *Ovoidites* (al. *Schizosporis*) *parvus* (Cookson & Dettmann) Nakoman, Ann. Soc. Geol. Nord., 86, p. 91.

Description: See Cookson & Dettmann (1959).
Dimensions: 73−79 μm in length and 41−49 μm in width; exine thin, laevigate; width/length ratio=0.562−0.62.
Occurrence: $KP_{1,2}$ middle (GN 5476) and upper (GN 5486).
Remarks: Nakoman (1966) transferred *Schizosporis parvus* Cookson & Dettmann to the genus *Ovoidites* without an explanation. The authors identify the present specimen with *Schizosporis parvus*, whereas it has much thinner exine than the original ones of Cookson & Dettmann.
Botanical affinity: Unknown.

Regional comparison

First investigation on western Anatolian assembalges of dispersed Neogene sporomorphs concentrated in a broad view on qualitative analysis. Even without precise denotation of defined stratigraphic horizons certain associations of sporomorphs rendered reference to three succeeding communities, two of them believed to discern Early and Late Miocene formations. This stratigraphic deduction was founded on perhaps restricted occurrences of potential index fossils as well as transient, quantitative changes of dominating sporomorphs within the assemblages. Nevertheless, it was admitted that definite subdivisions of Miocene deposits could not be achieved this way. The third assemblage was recognized in Pliocene continental deposits of southwest Anatolia, yielding spectra of almost identical form species as in Miocene formations but marked by impoverished diversities (Nakoman 1967).

Neogene rocks which were also accumulated in a similar facies as in Soma Dağlari in the Basin of Seyitömer (near Kutahya) called forth palynologic researches (Nakoman 1968; Arslan 1979). There, not only the top of the Turgut Member is marked by a workable lignite (seam A) but also a horizon with sporadic lignite (seam B) occurs within marlstones and clayey sands (Sekköy Member). The comprehensive investigation of the fossil sporomorphs from this basin (80 species) resulted again in the recognition of characteristic paleoecological trends during supposedly Late Miocene. These are manifested by the dominance of pinacean pollen (20−40%, *P. microalatus*) in the lower part of the Neogene sequence (? Turgut Member). Pinacean (15−25%), cyrillacean (10−25%, *Cyrillaceaepollenites megaexactus*) and considerable amounts of supposed castanean pollen (5−10%, *Cupuliferoipollenites cingulum*) are the major components of the associations in the middle part of the section (? lower Sekköy Member). A more balanced distribution of all these mentioned species together with a proportional maximum in both ? polypodiacean spores (5−10%, *Laevigatosporites haardti*) and ? castanean pollen (3−5%, *C. cingulum*) finally set marks to the upper units of ? Sekköy Member. Although no particular account is given as to the palynoflora of seam A (perhaps Lower Coal Bed) or seam B (perhaps equivalent of Middle Coal Bed of Soma coal filed) the quantitative biozonation of the basin fill—which in fact is merely based on the shifts in abundances of certain, long ranging species—was considered to present at least a valuable paleoecologic indication and eventually a relevant method for biostratigraphic comparison of sedimentary sequences (Nokoman 1968).

Once the continental deposits of Anatolian basins were shown to have in common striking lithofacies similarities (Becker-Platen 1971), palynology was challenged to support regional correlation as accurately as possible. A practical solution of this task seems to have been at hand, when quantitative methods were applied to evaluate certain trends in sporomorph associations of different geologic ages. This means that symptomatic fluctuations in the composition of fossil communities had to be recognized to evaluate their potentialities on biostratigraphic bearing. Such considerations were initiated and thereupon successfully carried out for the sake of applied filed geology by Benda (1971). From six sporomorph associations, which he recognized within the Anatolian Neogene section, three have to be considered more closely in this context. The relevant pollen spectra relate to environmental conditions and changes which came to pass during the Middle Miocene to Lower Pliocene span of time. In stratigraphical order this is at first the **Eskihisar Assemblage**, which is preserved in carbonaceous or lignitic deposits of lower Sekköy Member.

Apparently, there exists no qualitative difference between the Burdigalian-Serravallian **Pollen Assemblage of Kale** and the one of Eskihisar, although in the latter the record of certain sporomorph group seems to be comparatively impoverished. To sum up, Eskihisar Assemblage apparently displays drastically reduced amounts of triatrioporate specimens as well as less frequent so-called *Castanea*, *villensis*, *emmanensis* and *microreticulatus* pollen types. Other components (i. e. *Polyvestibulopollenites verus*, *Tricolpopollenites asper*) may, however, occur even more abundantly than in the Kale Assemblage. Nevertheless, quercoids (so-called *henrici-microhenrici* group) and pinacean (haploxylon types) remained dominant elements of this association. **Yeni-Eskihisar Assembalge** stratigraphically refers to the upper parts of Sekköy Member. It also consists to a large deal of quercoid pollen which are claimed to represent more advanced populations (*asper* type). They are mixed with significant amounts of *Monocolpopollenites areolatus* and *Periporopollenites stigmosus* groups, yet pinacean pollen continued to be dispersed from almost similar communities as revealed in Eskihisar assemblages.

Carbonaceous or lignitic clays of Yatağan Member finally preserved the **Assemblage of Kizilhizar**, which is marked by its relative enrichment in pollen of "modern" *Alnus* and *Ulmus*. Besides, certain group of pincean pollen (*silvestris* types) definitely grew in number whereas so-called *microhenrici-henrici* associates meanwhile are nothing but sporadically encountered.

Assumed, that such an evaluation of fossilized microfloras may result in useful biostratigraphic or even more paleoecologic information, such supposition needs further proof and solid taxonomic foundation. Terms like *haploxylon-silvestris* types, *henrici-microhenrici* group or quercoid forms do not mean very much in taxonomic terms. In fact, it can hardly be excluded that this way quite different populations may be lumped.

After all, previous palynologic research on western Anatolian Neogene deposits referred in the most to Central European taxa. Often enough this was done in rather broad outlines without indicating potentially new forms. Notwithstanding, it was mentioned by Benda (1971) that 7−19% of the specimens he had studied from Soma Dağlari coal fields were either unknown to him or not at all identifiable. This evidenced taxonomic uncertainty corresponds as chance would have it with the number of newly introduced forms in Nakoman's publication on Late Miocene microfloras of Seyitömer Basin. They amount to approx. 18% of his species assemblange. In the present study, too, approx. 9% of the identified palynomorphs yet appeared to be undescribed. Considering this handicap, consultation of relevant regional literature is no easy task rendering precise biostratigraphic correlation of both rock and time units a precarious attempt. Furthermore, the separation of taxonomic groups is not at all similarly performed but present itself as highly subjective. One may deduce this from a list (Tab. 2) which echoes the different dispositions of taxonomic interpretation by the variation of adjoined genera and appertaining species.

Tab. 2. Summarized pollen spectra from limnic Neogene deposits of Soma Dağlari and its surroundings. Indices refer to both the number of identified form genera (= numerator) and species (= **denominator**) of differentiated taxonomic groups. Roman numbers on top read as follows: I = Trilete microspores, II = Monolete microspores, III = Inaperturate pollen, IV = Saccate pollen, V = Polyplicate pollen, VI = Monocolpate pollen, VII = Tricolpate pollen, VIII = Tricolporate pollen, IX = Tetracolpate pollen, X = Monoporate pollen, XI = Triporate pollen, XII = Periporate and Polyporate pollen, XIII = Ovoidites capsules.

Region	Taxonomic groups													
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	n.sp.
Soma Daglari	4	1	7	6	1	5	8	8	1	1	8	6	1	17
(present study)	**5**	**5**	**16**	**32**	**3**	**9**	**31**	**35**	**1**	**4**	**16**	**6**	**3**	
Soma Daglari		1	1	1		1	1	1		1	5	1	1	
(BENDA in BRINKMANN)		**1**	**2**	**1**		**1**	**6**	**1**		**1**	**5**	**2**	**1**	
Eskihisar Ass.	5	1	6	6		1	5	5		2	7	6		
(BENDA 1971)	**5**	**1**	**6**	**6**		**1**	**6**	**9**		**2**	**7**	**6**		
Akhisar Coal F.	7	1	1	1		1	1	1	1	1	5	1	1	
(Akgün et al.1987)	**9**	**1**	**4**	**5**		**1**	**10**	**19**	**5**	**2**	**17**	**2**	**2**	
Evçiler Coal F.	1	1	1	1		1	1	1	1	1	5	1	1	
(Akgün et al.1986)	**2**	**2**	**5**	**2**		**2**	**11**	**7**	**3**	**2**	**13**	**1**	**1**	
Seyitömer Basin	8	4	1	2		1	1	1	1	1	6	1	1	23
(NAKOMAN 1968)	**17**	**4**	**4**	**12**		**4**	**6**	**22**	**6**	**2**	**10**	**5**	**4**	
Neog. SW-Anatolia	5	1	1	3		1	1	1	1	1	6	1	1	
(NAKOMAN 1967)	**11**	**1**	**6**	**6**		**8**	**8**	**14**	**1**	**3**	**11**	**2**	**1**	

Biostratigraphic evaluation of Soma Dağlari palynomorphs

The following arguments are based on the identification and taxonomic description of palynomorphs which were separated from lignites and carbonaceous clay incorporated into Lower, Middle and Upper Coal Beds. All of these horizons are exposed in the open mines of Soma Dağlari. Samples were taken from the base, middle and top of both Burdigalian $KM_{1,2}$ and Tortonian $KP_{1,2}$ seams which are worked at Kisrakdere West (Bati) and Kisrakdere East (Dogu).

Serravallian-Langhian KM_3 seam is finally represented not only from Kisrakdere West but also from Merkez Munja.

As a result, the comprehensive investigation of the microfloral remains revealed a considerable diversity in species, much greater than was to be expected from previous research on the subject. It also turned out, that the fossil assemblages exhibit noteworthy alterations in vertical distribution. Of course, there is quite a number of well known and widely dispersed sporomorphs which were also recorded here in long duration almost from base to top of the Miocene section, either punctually or even continuously. These are the following species, amounting to approx. 42% of the total assemblage: *Laevigatosporites dehiscens, L. ovoideus, Abiespollenites absolutus, Cedripites pseudodeodaraeformis* n. sp., *Piceapollis minor, P. praemarianus, P.* sp., *Pityosporites labdacus labdacus, P. macroinsignis, P.* cf. *pristinipollinius, Podocarpidites podocarpoides, Cupressacites* cf. *cuspidataeformis, C. insulipapillatus, Inaperturopollenites dubius, I. laevigatus, I. parvus, Psophosphaera aggereloides, P. pseudotsugoides, Sequoiapollenites polyformosus, Ephedripites (E.) minor, Monopunctites* sp., *Potamogetonacidites difficilis, Monocolpopollenites intrabaculatus, M. kyushuensis, Graminidites laevigatus, G. subtiliglobosus, Carpinuspollis carpinoides, Polyatripollenites stellatus, Polyvestibulopollenites verus, Ulmipollenites undulosus, Zelkovaepollenites potoniei, Cupuliferoidaepollenites fallax, C. longus, C. weylandii, Quercoidites densus, Q. henrici, Q. microdensus, Q. microhenrici, Striatopollis circularis* n. sp., *S.* sp., *Tricolpites retiformis, Tricolpopollenites anatolicus* n sp., *T. asper, T. chagrenatus, T. pseudoasper, T.* sp. a, *Cupuliferoipollenites pusillus, Ilexpollenites tertiarius, Intrabaculitricolporites consularis consularis, I. ellipsoideus, I.* sp. b, *Betulaepollenites* sp., *Caryapollenites simplex simplex, Engelhardtioidites microcorypaeus, Engelhardtioipollenites punctatus, Momipites somaensis* n. sp., *Subtriporopollenites kyushuensis, Triatriopollenites rurensis, T.* sp., *Triporopollenites shimensis, T. moderatus* n. sp., *T. subfragilis, T.* sp., *Monogemmites* *pseudosetarius, Ovoidites lanceolatus* n. sp., *O. pseudoligneolus, Schizosporis ellipsoideus* n. sp.

On ther other hand, there is a good few of species evidently restricted to Lower or Upper Coal Bed and some of them may turn out to be index fossils. Almost 30% of the species encountered were only observed in the KM$_{1,2}$ seam reflecting a definite dominance of coniferous pollen.

Cicatricosisporites sp., *Monoleiotriletes gracilis, M.* sp., *Punctatisporites* sp., *Verrucingulatisporites* cf. *grandis, Laevigatosporites aegyptiacus, L. turcicus*n. sp., *Abiespollenites* cf. *absolutus, A. microsaccoides,* ? *A. minor, Cedripites anatolicus* n. sp., *C. miocaenicus, C. szaszvarensis,* ? *C.* sp., *Piceapollis anatoliensis* n. sp., *P. neogenicus, P. planoides, P.* cf. *sacculiferoides, P. tobolicus, P. labdacus maximus, P. miocaenicus, Podocarpidites verrucorpus, Sequoiapollenites gracilis, S. largus, S.* sp., *Zonalapollenites maximus, Arecipites brandenburgensis, A.* sp., *Monocolpopollenites tranquillus, Monosulcites* sp., *Graminidites* sp., *Cupuliferoidaepollenites facetus, Quercoidites* cf. *punctatus, Retitrescolpites globosus* n. sp., *Tricolpites* cf. *minutireticulosus, Tricolpopollenites robusteus, Cupuliferoipollenites fusus, C.* sp., *Rhoipites minus, R. retiformis, R. rotundus, R.* sp. b, *Striatocolporites* sp. b, *Tricolporopollenites* sp. b, *T.* sp. c, *Tiliaepollenites instructus, Triatriopollenites pseudorurensis, Trivestibulopollenites betuloides*.

Many of these 48 sporomorphs were only recorded at the base of KM$_{1,2}$ seam (underlined species in the list above: 52%), whereas in its middle and upper parts such a restriction of total assemblage was just noted in 19% and 12% respectively.

No distinct grouping of a peculiar KM$_3$ microflora (Serravallian-Langhian) is yet discernible as not any of the well identified species seems to be exclusively restricted to this horizon: ? *Podocarpidites* sp., *Cycadopites* sp., ? *Smilacipites* sp., *Retitrescolpites*sp. a, *Intrabaculitricolporites* sp. a, *Momipites* sp.

Nevertheless, there are some palynomorphs which already recorded in the Lower Coal Bed (underlined species in subsequent list) and others which range from KM$_3$ to KP$_{1,2}$ seam: *Piceapollis minor* n. sp., *Pityosporites labdacus labdacus, P.* cf. *pristinipollinius, Podocarpidites podocarpoides, Psophosphaera aggereloides, Monopunctites* sp., *Monocolpopollenites intrabaculatus, M. kyushuensis, Quercoidites densus, Striatopollis* sp., *Intrabaculitricolporites ellipsoideus, Triatriopollenites* sp., *Triporopollenites moderatus* n. sp., *T* sp., *Monogemmites pseudosetarius, Ovoidites lanceolatus* n. sp., *O. pseudoligneolus, Schizosporis ellipsoideus* n. sp.

Even if the microflora has many aspects in common with the one identified from the Lower Coal Bed, a regrouping of the association is noticeable, producing the impression of a transitional biofacies. Accordingly, 24% of all species notified in the three coal beds derive from $KP_{1,2}$. This might very well hint at a significant change in the Tortonian flora of Soma Dağlari compared with the older ones. No longer were conifer principal contributors of sporomorphs but angiosperms. The latter added to the pollen assemblages in particular by willows and a considerable variety of herbs and shrubs: *Laevigatosposporites undulatus*, *Pityosporites aralicus*, *P. baileyanus*, *Podocarpidites andiniformis*, *P. nageiaformis*, *Sequoiapollenites* cf. *pilaeligulus*, *Ephedripites* (*E.*) *anatolicus* n. sp., *E.* (*E.*) *hungaricus*, *Smilacipites* sp., *Arecipites pflugii*, *Graminidites* cf. *laevigatus*, *Ranunculacidites* sp., *Tetracolpites* sp., *Chenopodipollis multiplex*, *Quercoidites somaensis* n. sp., *Tricolpites rudis*, *T.tecturatus* n. sp., *T.* sp. a, *T.* sp. b, *T.* sp. c, *Compositoipollenites denizliensis*, *Cyrillaceaepollenites megaexactus*, *Ilexpollenites margaritatus*, *Intrabaculitricolporites consularis globularis*, *Nyssapollenites kruschi* asp. *pseudolaesus*, *Rhoipites* cf. *bradleyi*, *R. finitus*, *R. mirus*, *R.* sp. a, *Striatocolporites ovuliformis*, *S.* sp. a, *Tricolporopollenites pseudochagrenatus*, *T. turcianus* n. sp., *T.* sp. d, *T.* sp. e, *T.* sp. f, *Ovoidites raatzi*, *Schizosporis cooksoni*, *S.* cf. *parvus*.

Botanical affinities

A great deal (10−25%) of Soma Dağlari sporomorphs still escapes proper designation or is at least only ambiguously and doubtfully classified systematically. In spite of this handicap, the majority of the form species involved is coordinated with definite plant families, often enough even with genera. Accordingly, the assemblage of dispersed sporomorphs from the three Miocene coal beds can be arranged into the following growth communities.

1. Ferns with Schizaeaceae, Polypodiaceae (also unidentified trilete spores)
2. Conifer trees with Pinaceae (*Abies*, *Cedrus*, *Picea*, *Pinus*), Podocarpaceae (*Podocarpus*), Cupressaceae-Taxodiaceae (*Juniperus*, *Larix*, *Sequoia*, *Tsuga*).
3. Angiosperm trees with Betulaceae (*Alnus*, *Betula*, *Carpinus*), Cupuliferae (*Quercus*), Fagaceae (*Castanopsis*, *Castanea*), Juglandaceae (*Carya*, *Engelhardtia*), ? Palmae, Tiliaceae (*Tilia*), Ulmaceae (*Ulmus*, *Zelkova*).
4. Shrubs with Aquifoliaceae (*Ilex*), Cyrillaceae, (*Cyrilla*), Myricaceae, (*Myrica*), Oleaceae, Salicaceae (*Salix*).

5. Herbs with Chenopodiaceae, Compositae, Ephedraceae, Liliaceae, Gramineae, Labiotae.
6. Aquatic plants with Potamogetonaceae.
7. Rest group includes pollen and palynomorphs of unknown affinities like *Monopunctites, Tetracolpites, Striatopollis, Intrabaculitricolporites, Rhoipites, Striatocolporites, Tricolporopollenites, Monogemmites, Ovoidites*, and *Schizosporis*.

Sorted out in this way (Fig. 5), sporomorphs apparently demonstrate that there is little alteration in the community patterns of palaeofloras derived from the three stratigraphic levels. Although an obviously well adjusted

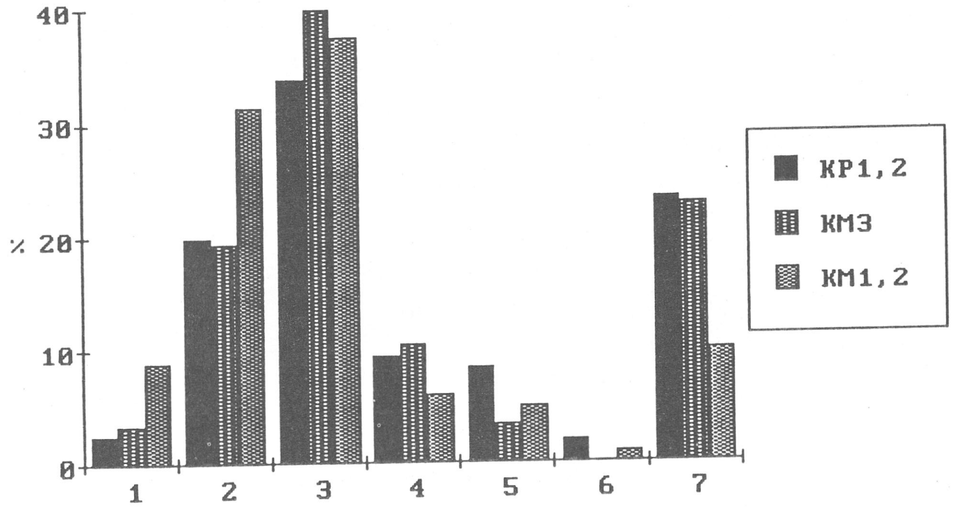

Fig. 5. Miocene sporomorphs from the three Coal Beds stratigraphically arranged according to growth communities. Numbers below columns read as follows: 1=ferns, 2=conifer trees, 3=angiosperm trees, 4=shrubs, 5=herbs, 6=aquatics, 7=affinities unknown.

association is reflected in each of the coal beds by just dispersed sporomorphs, the phenomena may serve as an objective hint that autochthonous and natural assembalges are under discussion. Nevertheless, ferns and conifers have decreased, shrubs slightly increased and angiosperm trees more or less retained their number of species in the pace of time.

As mentioned above, species diversity appears to increase somewhat from base to top of the section, ranking high in each of the three horizons investigated. However, conifer are particularly abundantly encountered in $KM_{1,2}$, even when Taxodiacean-Cupressacean dominate the spectra of Lower and Middle Coal Beds with just one species (50% *Inaperturopollenites dubius*).

Tab. 3. Numerical relation of dispersed sporomorphs from the three Coal Beds between conifer and angiosperm tree communities.

coal beds	conifer trees gen./spec.	angiosperm trees gen./spec.	conifers/angiosperms gen./spec.
$KP_{1,2}$	9/20 (=0.45)	21/40 (=0.52)	0.43/0.50
KM_3	7/11 (=0.64)	13/24 (=0.54)	0.53/0.50
$KM_{1,2}$	10/33 (=0.30)	20/40 (=0.50)	0.50/0.82

Somewhat altered ratios of sporomorph form genera and species inform on vegetational changes within geological times. From this it can be concluded that obviously angiosperm trees slightly took over at the expense of conifers.

Although certain trends are evident, referring to either local modifications of the hydrodynamic regimes or, more likely, to slowly operating paleoclimatic changes of a regional sway, fig. 5 does not register specific intercommunity changes which are, of course, of uttermost importance in biostratigraphy.

Biostratigraphic evidence of sporomorph assemblages

Lower and Middle Coal Beds were formerly conceived to represent Miocene and Upper Coal Bed Early Pliocene deposits (Ketin 1983). This stratigraphic designation had to be revised on account of the radiometrically dated pyroclasts from correlated Neogene sections in West Anatolia (Becker-Platen et al. 1977). This almost confirmed the original stratigraphic arrangement of the Neogen successions as proposed by Brinkmann et al. (1971). It was already mentioned before that most of the sporomorphs which were identified from Late Burdigalian $KM_{1,2}$ horizon are noted to have rather wide stratigraphic ranges. Therefore, it is no easy task to denote such fossils which may indicate Lower or Middle Miocene at least. Nevertheless, sporomorphs which are listed on fig. 6 appear to be unknown from Late Miocene or Early Pliocene deposits.

There are other sporomorphs which seem to be bound to $KM_{1,2}$ seam, but in other regions they were observed in Late Neogene deposits too. These are the following species: *Piceapollis planoides* (Miocene-Pliocene), *P. tobolicus* (Oligocene-Pliocene), *Pityosporites labdacus maximus* (Miocene-Pliocene), (*Sequoiapollenites largus* (Miocene-Pliocene), *Trivestibulopollenites betuloides* (Late Eocene-Pliocene), and *Tiliaepollenites instructus* (M. Oligocene-Pliocene).

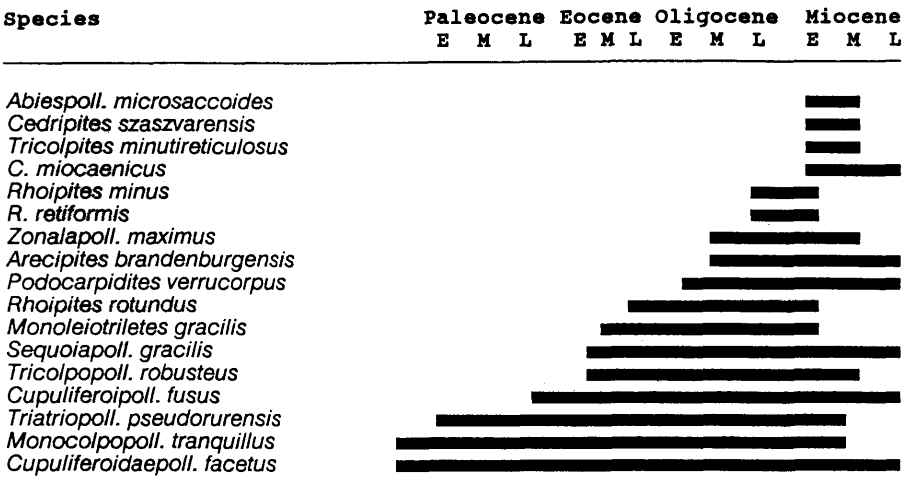

Fig. 6. Known stratigraphic ranges of sporomorphs from the Lower Coal bed.

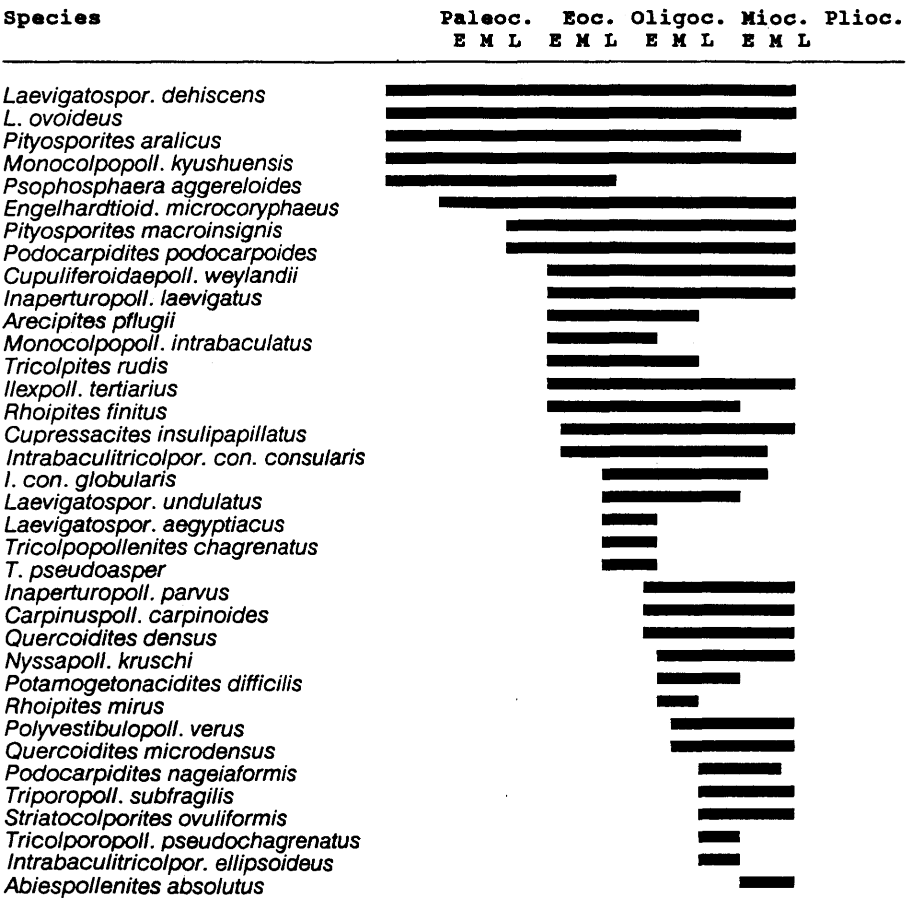

Fig. 7. Known stratigraphic ranges of sporomorphs from the Upper Coal bed.

Even in the Upper Coal Bed most of the sporomorphs have already been observed in Paleogene deposits elsewhere, except three species: *Ephedripites hungaricus*, *Graminidites laevigatus*, *Engelhardtioipollenites punctatus*. They may be restricted to Miocene-Pliocene formations. Nevertheless, almost 55 % of the species derived from Tortonian $KP_{1,2}$ seam are quite unknown from Pliocene sequences (Fig. 7).

Certainly, the stratigraphic ranges of all these extend at least into Late Miocene (Tortonian) but this obviously does not support the assumption that the Upper Coal Bed could have a Pliocene age. The biostratigraphic interpretation of the sporomorph assemblages, however, adequately corresponds with the radiometric ages of Tortonian Yatağan, Serravallian-Langhian Sekköy and Late Burdigarian Turgut Members (Becker-Platen et al. 1971). Taking this conclusion for granted, the palynoflora described above reflects in any case paleoecologic and paleoclimatic conditions prevailing on one of the Anatolian intermontane basins during three wet and warm-temperate phases of Early, Middle and Late Miocene.

Comparing the Late Burdigarian ($KM_{1,2}$), Serravallian-Langhian (KM_3) and Tortonian ($KP_{1,2}$) sporomorph assemblages it has to be kept in mind, that only incomplete data on the paleoflora are available by palynological methods. *Cinnamomum* leaves are for instance quite commonly preserved in the lacustrine marls (Lower Sekköy Member: Marlstone Unit) above the Lower Coal Bed, although the appertaining pollen grains, which are in fact not preservable, are of course missing. Even though, the assemblages noted relate to quite different biotopes. On the one hand plantal communities of lowland swamps and bogs are represented by dispersed sporomorhps, which eventually may even be distinguished as groups of dry peaty substrates (? *Sequoiapollenites*), more swampy grounds (*Inaperturopollenites dubius*) and open pools (*Potamogeton*, *Ovoidites*). On the other hand, the formerly adjacent mixed hillside forests (Pinacean, Fagacean, Lauracean, Juglandacean) were obviously major contributors to the fossil palynofloras,

Evidently there grew another coniferous tree community (fir, spruce, hemlock) higher up on the mountains which added to the palynoflora particularly in times when the valley floors were less covered by shrubs and trees due to the rise of groundwater. If a comparison is drawn with reconstructed paleoenvironments of other regions, the Miocene plant communities of Soma Dağlari seem to accord quite well with the somewhat older ones (Late Oligocene), described from the Petrosani Basin (Jiu valley) in Rumania (Petrescu & Givulescu 1986).

All this indicates a pronounced influence of paleorelief in this area throughout the Miocene. Increasing species diversity among herds and conifers may, however, point at changing climatic conditions already during Early Tortonian.

Plant communities and successions

Within the coal seams the sporomorph assemblages are by far not alike in composition, at least when just the spectra of lower, middle and upper horizons are compared with each other (Fig 8). This certainly figures out not only the general pattern of former vegetation but also the successions and perhaps even the arrangements of ecologically significant plant groups.

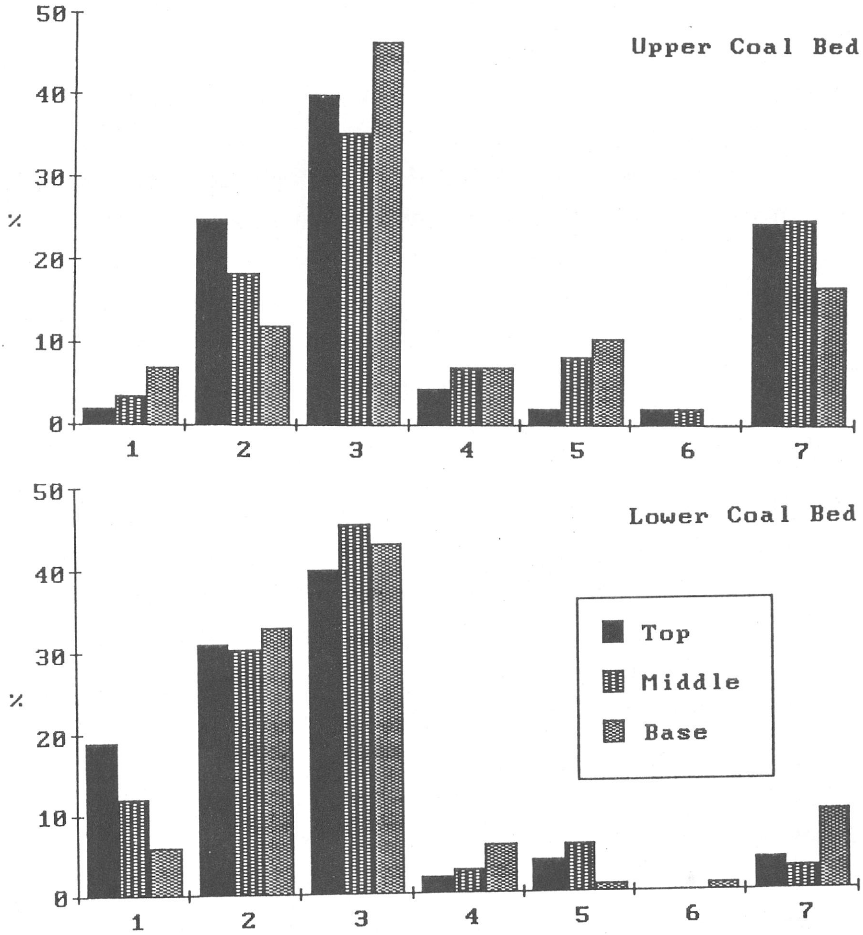

Fig. 8. Summarized pollen spectra of Upper and Lower Coal Beds to show variation of seven plantal growth groups with regard to three different levels in the seams. Numbers below read as follows: 1=spores, 2=conifer trees, 3=angiosperm trees, 4=shrubs, 5=herbs, 6=aquatics, 7=affinities unknown.

In the Lower Coal Bed at first a swampy depression with streams and water pools in the midst of mountainous forests is figured out. On the moist soil obviously grew ferns (Polypodiaceae, Schizaeaceae) and shrubs (Cyrillaceae, Myricaceae), whereas herbs (Liliaceae) and aquatic plants (Potamogetonaceae) framed the sites of open water. There was a bushy belt of woody plants (Salicaceae, Betulaceae) on somewhat elevated ground, but on the valley slopes a mixed oak forest of high species diversity (Cupuliferae, Fagaceae, Juglandaceae, Podocarpaceae, Pinaceae, Tiliaceae, Ulmaceae) flourished. Lower patches of taxodiacean and cupressacean trees (*Inaperturopollenites dubius, Sequoiapollenites*) presumably were attached to it. Anyhow, on the summits of the hills grew conifers such as cedar, fir and spruce. Nevertheless, the total assemblage of sporomorph species shows a clear dominance of angiosperm trees (43%) in spite of the fact, that more than 50% of the counted specimens were identified as *Inaperturopollenites dubius*. This may refer to both the lowland stands of taxodiacean-cupressacean communities and the restricted reaches of former pollen transport.

The middle part of the Lower Coal Bed reveals noteworthy alterations of the sporomorph association compared to the one from below. In spite of that, pollen of Cupressaceae-Taxodiaceae still yield more than 50% of the assemblage with just one species (*Inaperturopollenites dubius*). Certainly species diversity became reduced and especially tree populations had impoverished. Among conifers no pollen grains of sedar, hemlock, larch or podocarpacean affinity were recognized, whilst angiosperms lack willows and birches. Furthermore, there are less species to be registered among spruces, pines, oaks, fagacean as well as juglandcean trees. Myrtle groves and ferns certainly persisted on moist substrates, yet the slight change to drier climatic conditions is perhaps expressed by the occurrence of grass pollen.

Also in the upper part of $KM_{1,2}$ seam the fossil microflora does not show the species diversity as from below, although the pollen spectrum is not very different. Anyhow, a reorganization of the vegetation is hinted by the reoccurrence of cedars and birches as well as the increased species number of spruces and juglandacean trees. On the other hand species of oaks appear to be less in number whilst linden, chesnuts and palms eventually disappeared from the surroundings of the boggy valleys. There, ferns regained ground as did herbs with newly appeared Ephedra pollen.

Although the Lower Coal Bed submerged as shown by its overburden of lacustrine marls and limestones (Sekköy Member), there is yet no indication in the pollen spectrum derived from the upper part of $KM_{1,2}$ seam, that humidity increased significantly all over the place, except increasing species diversity of fern spores.

Compared with the Lower Coal Bed ($KM_{1,2}$) the amount of identified sporomorph species appears to be reduced to some extent in the Upper Coal Bed ($KP_{1,2}$), however, it has to be considered that the $KP_{1,2}$ spectra contain considerably more taxa with unknown botanical affinities than the ones of $KM_{1,2}$. The sporomorph assemblage of the basal part of the Upper Coal Bed abounds in tree pollen. A variety of angiosperms (alder, birch, oaks, elms, juglandaceans, willows) is noted whereas conifers (cedar, cupressacean, taxodiacean) are not as common. Also shrubs (hollies. myrtles), herbs (chenopodiaceans) are quite frequently represented, but the pollen of aquatic plants was not observed whatever.

In the middle part of $KP_{1,2}$ seam a rise in groundwater is evidenced by the appearance of pollen from pondweeds, additional willows and even *Monogemmites* (? fresh water cyst). Favoured by partially open boggy lowlands the deposition of saccate pollen from higher stands markedly increased giving record of fir, pine, spruce and Chinese black pine. To the assemblage of angiosperm trees noted already before, tupelo and palms were added, yet as a consequence of the altered edaphic situation the diverity of herbs became reduced. The composition of the pollen spectrum obtained from the upper level of $KP_{1,2}$ seam differs only slightly from the one before and concurs with the trends then perceived. Pines contributed additional species to the conifers; chestnuts incorporated the mixed forest assemblage of elms, juglandaceans, palms and oaks, the latter still being the dominating group in the local vegetation. Open pools surrounded by grass patches, thickets of alder, willow and birch maintained their places in the boggy depressions whilst on the lower mountain slopes clusters of bushes (myricaceans, cyrillaceans) linked with the hillside forests.

Lacustrine deposits (Upper Yatağan Member: Volcano-Sedimentary Unit) on top of $KP_{1,2}$ seam finally inform on a rather sudden rise of the local ground water level. This drowned the bog and may trace back to damming of former run offs by volcanic implication.

Tab. 4. Stratigraphic ranges of Soma Dağlari palynomorphs within the three Coal Beds ($M_{1,2}$, KM_3 and $KP_{1,2}$).

	KM_{1-2} Low.	KM_{1-2} Mid.	KM_{1-2} Up.	KM_3 Merk.	KM_3 Kisr.	KP_{1-2} Low.	KP_{1-2} Mid.	KP_{1-2} Up.
SPORES								
Cicatricosisporites sp.	■							
Monoleiotriletes gracilis		■						
Monoleiotriletes sp.	■							
Punctatisporites sp.	■							
Verrucingulatisporites cf. *grandis*			■					
Laevigatosporites aegypticus			■			■		
Laevigatosporites dehiscens	■	■	■	■		■	■	
Laevigatosporites ovoideus		■	■		■	■	■	■
Laevigatosporites turcicus		■	■					
Laevigatosporites undulatus						■		
GYMNOSPERMOUS POLLEN								
Abiespollenites absolutus	■	■	■				■	
Abiespollenites microsaccoides	■							
?*Abiespollenites minor*			■					
Cedripites anatolicus	■		■					
Cedripites miocaenicus	■							
Cedripites pseudodeodaraeformis	■					■		
Cedripites szaszvarensis			■					
?*Cedripites* sp.			■					
Piceapollis anatoliensis			■					
Piceapollis minor	■		■	■				
Piceapollis neogenicus	■							
Piceapollis planoides	■							
Piceapollis praemarianus		■	■					■
Piceapollis cf. *sacculiferoides*			■				■	
Piceapollis tobolicus		■	■					
Piceapollis sp.	■		■				■	■
Pityosporites aralicus								■
Pityosporites baileyanus								■
Pityosporites labdacus labdacus			■	■				
Pityosporites labdacus maximus	■							
Pityosporites macroinsignis	■	■						■
Pityosporites miocaenicus	■							
Pityosporites cf. *pristinipollinius*				■			■	■

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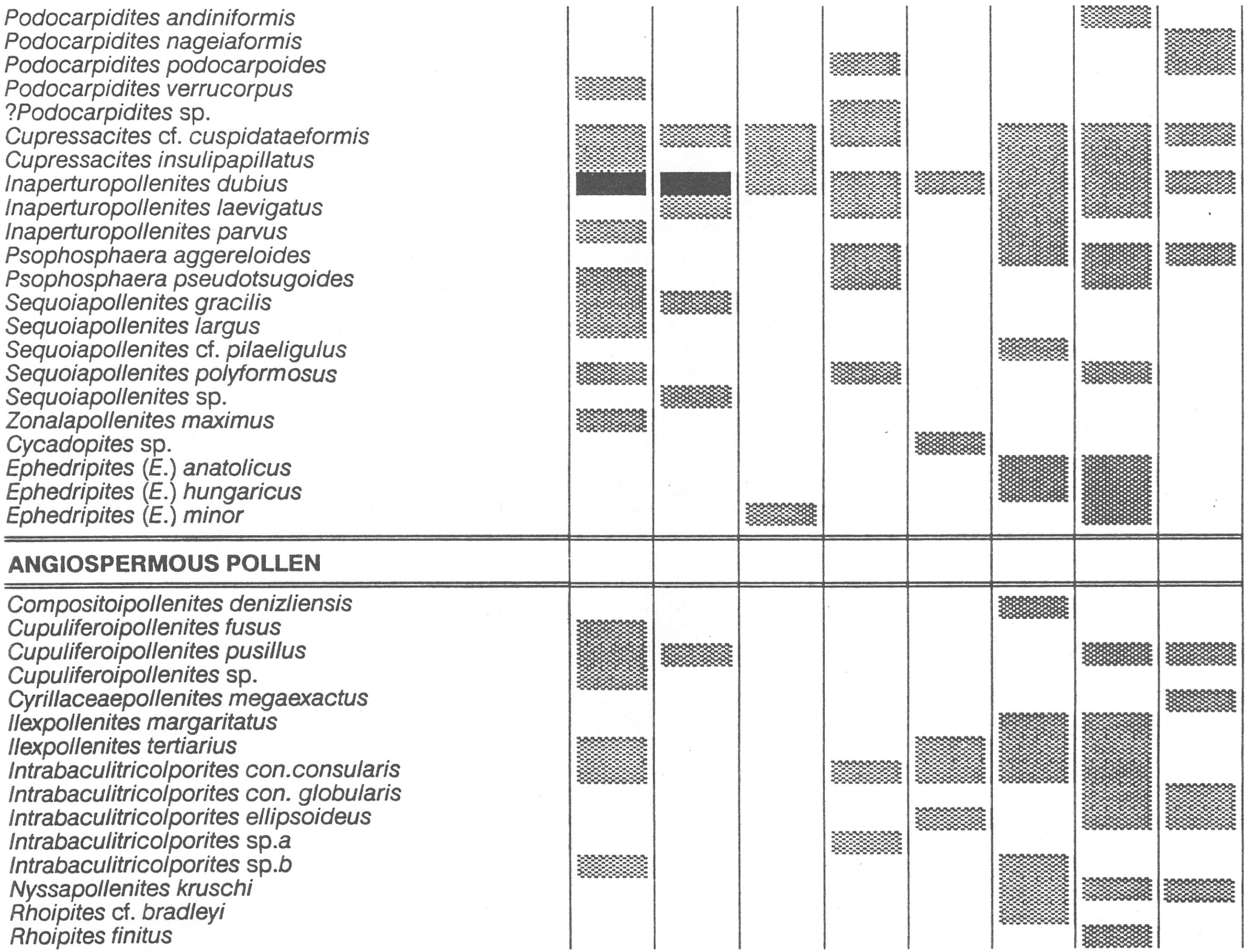

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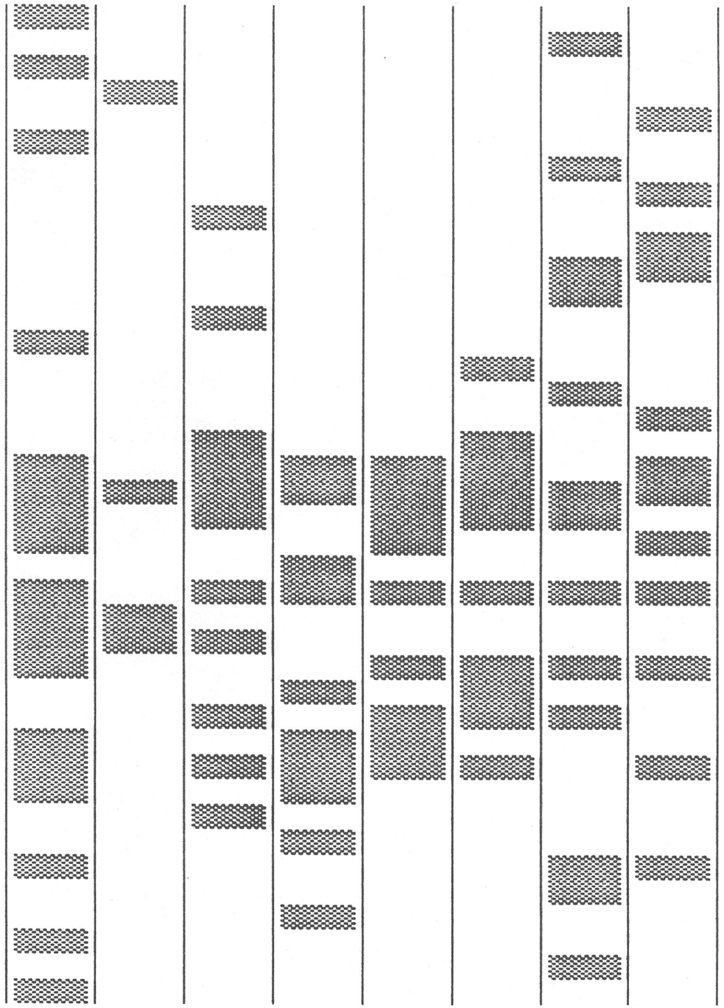
Rhoipites minus
Rhoipites mirus
Rhoipites retiformis
Rhoipites rotundus
Rhoipites sp.*a*
Rhoipites sp.*b*
Striatocolporites ovuliformis
Striatocolporites sp.*a*
Striatocolporites sp.*b*
Tricolporopollenites pseudochagrenatus
Tricolporopollenites turcianus
Tricolporopollenites sp.*a*
Tricolporopollenites sp.*b*
Tricolporopollenites sp.*c*
Tricolporopollenites sp.*d*
Tricolporopollenites sp.*e*
Tricolporopollenites sp.*f*
Betulaepollenites sp.
Caryapollenites simplex simplex
Engelhardtioidites microcoryphaeus
Engelhardtioipollenites punctatus
Momipites somaensis
Momipites sp.
Subtriporopollenites kyushuensis
Tiliaepollenites instructus
Triatriopollenites pseudorurensis
Triatriopollenites rurensis
Triatriopollenites sp.
Triporopollenites shimensis
Triporopollenites moderatus
Triporopollenites subfragilis
Triporopollenites sp.
Trivestibulopollenites betuloides
Monopunctites sp.
Potamogetomacidites difficilis
Smilacipites sp.
?*Smilacipites* sp.
Arecipites brandenburgensis
Arecipites pflugii
Arecipites sp.



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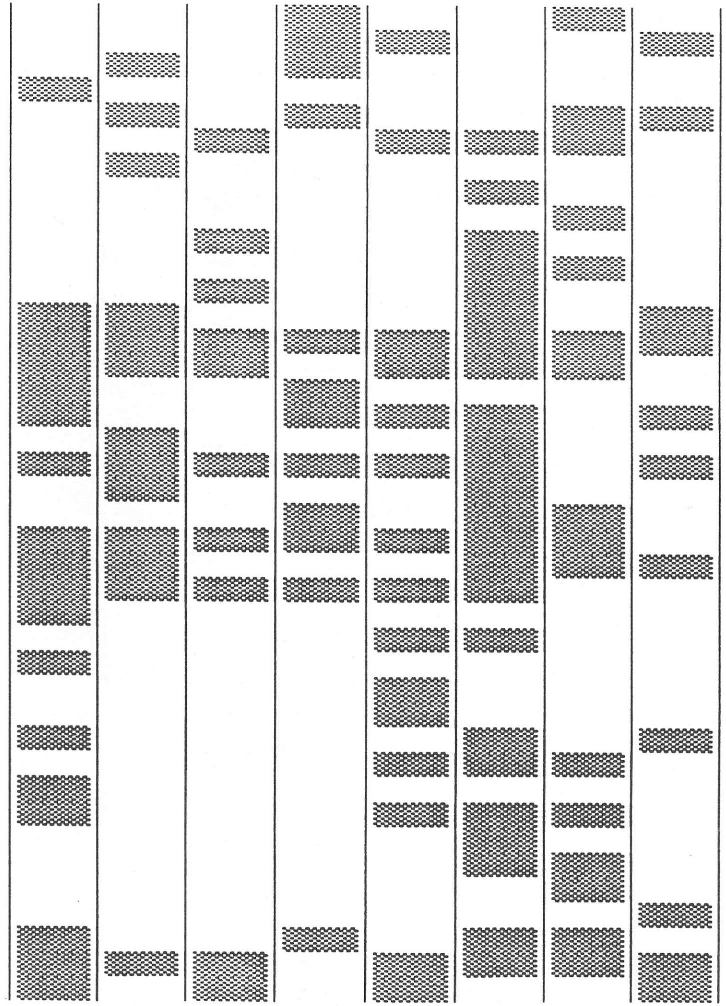
Monocolpopollenites intrabaculatus
Monocolpopollenites kyushuensis
Monocolpopollenites tranquillus
Monosulcites sp.
Graminidites laevigatus
Graminidites subtiliglobosus
Graminidites sp.
Ranunculacidites sp.
Tetracolpites sp.
Carpinuspollis carpinoides
Chenopodipollis multiplex
Polyatriopollenites stellatus
Polyvestibulopollenites verus
Ulmipollenites undulosus
Zelkovaepollenites potoniei
Cupuliferoidaepollenites facetus
Cupuliferoidaepollenites fallax
Cupuliferoidaepollenites longus
Cupuliferoidaepollenites vulgaris
Cupuliferoidaepollenites weylandii
Quercoidites densus
Quercoidites henrici
Quercoidites microdensus
Quercoidites microhenrici
Quercoidites cf. *punctatus*
Quercoidites somaensis
Retritrescolpites globosus
Retritrescolpites sp. a
Retritrescolpites sp. b
Striatopollis circularis
Striatopollis sp.
Tricolpites minutireticulosus
Tricolpites retiformis
Tricolpites rudis
Tricolpites tecturatus
Tricolpites sp. a
Tricolpites sp. b
Tricolpopollenites anatolicus
Tricolpopollenites asper
Tricolpopollenites chagrenatus



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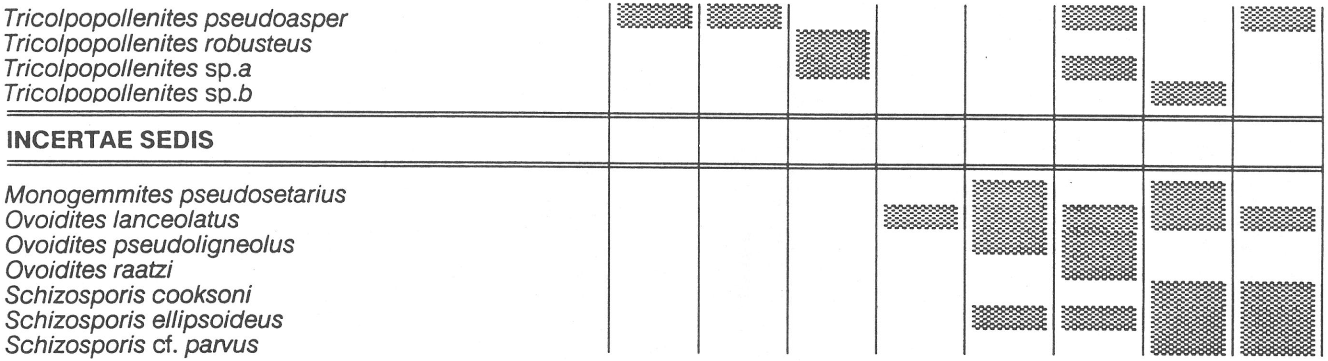

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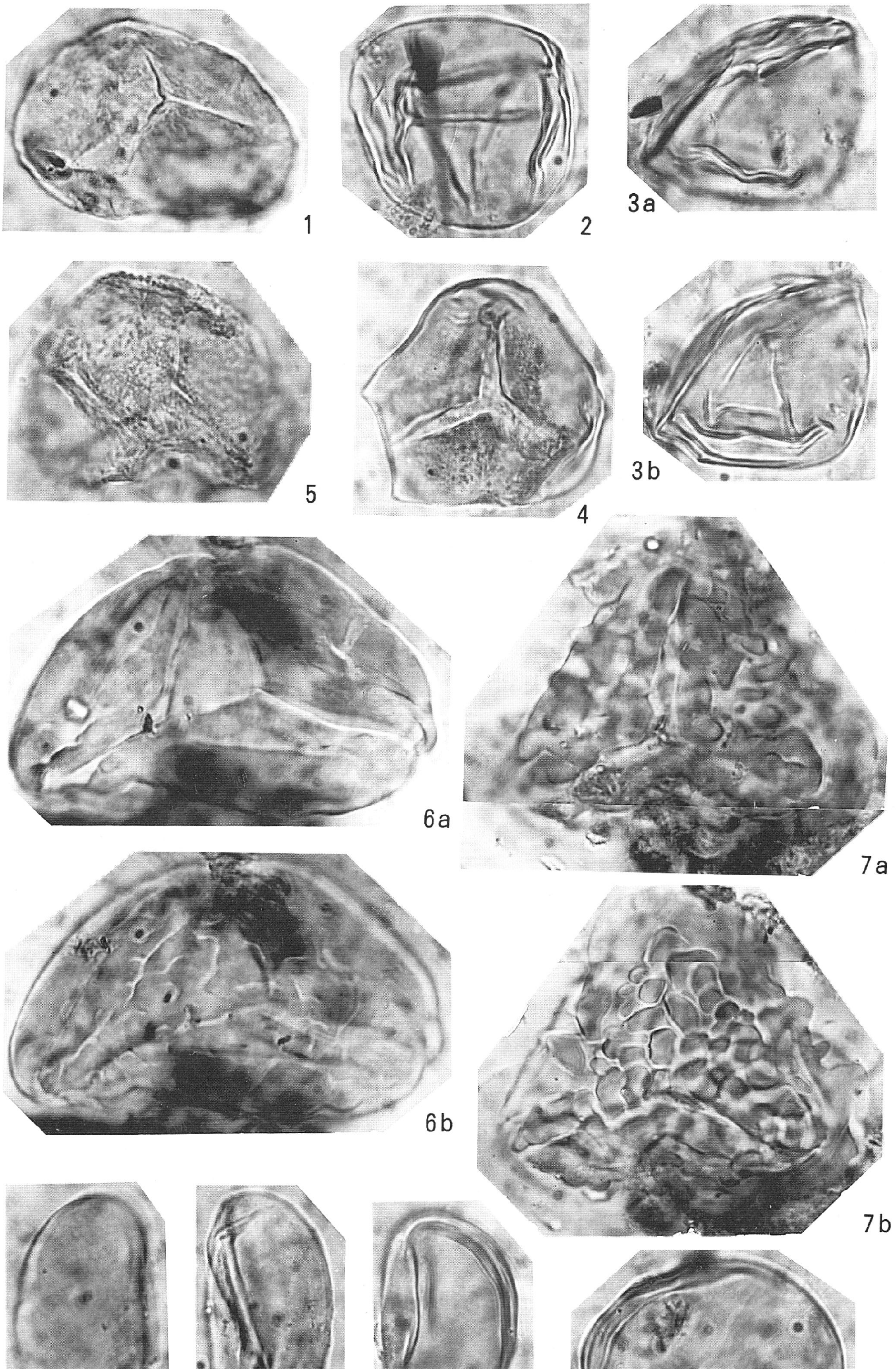
Explanation of plate 1
(All figures magnified X 1000)

Fig. 1.	*Monoleiotriletes* sp. GN 5401, $KM_{1,2}$ lower.
Figs. 2—4.	*Monoleiotriletes gracilis* Krutzsch GN 5412, $KM_{1,2}$ middle.
Fig. 5.	*Punctatisporites* sp. GN 5401, $KM_{1,2}$ lower.
Figs. 6 a—b.	*Cicatricosisporites* sp. GN 5401, $KM_{1,2}$ lower.
Figs. 7 a—b.	*Verrucingulatisporites* cf. *grandis* Nagy GN 5421, $KM_{1,2}$ upper.
Figs. 8—11.	*Laevigatosporites dehiscens* Takahashi Fig.8: GN 5423, $KM_{1,2}$ upper; fig. 9: GN 5421, $KM_{1,2}$ upper; fig. 10: GN 5401, $KM_{1,2}$ lower; fig. 11 GN 5402, $KM_{1,2}$ lower.

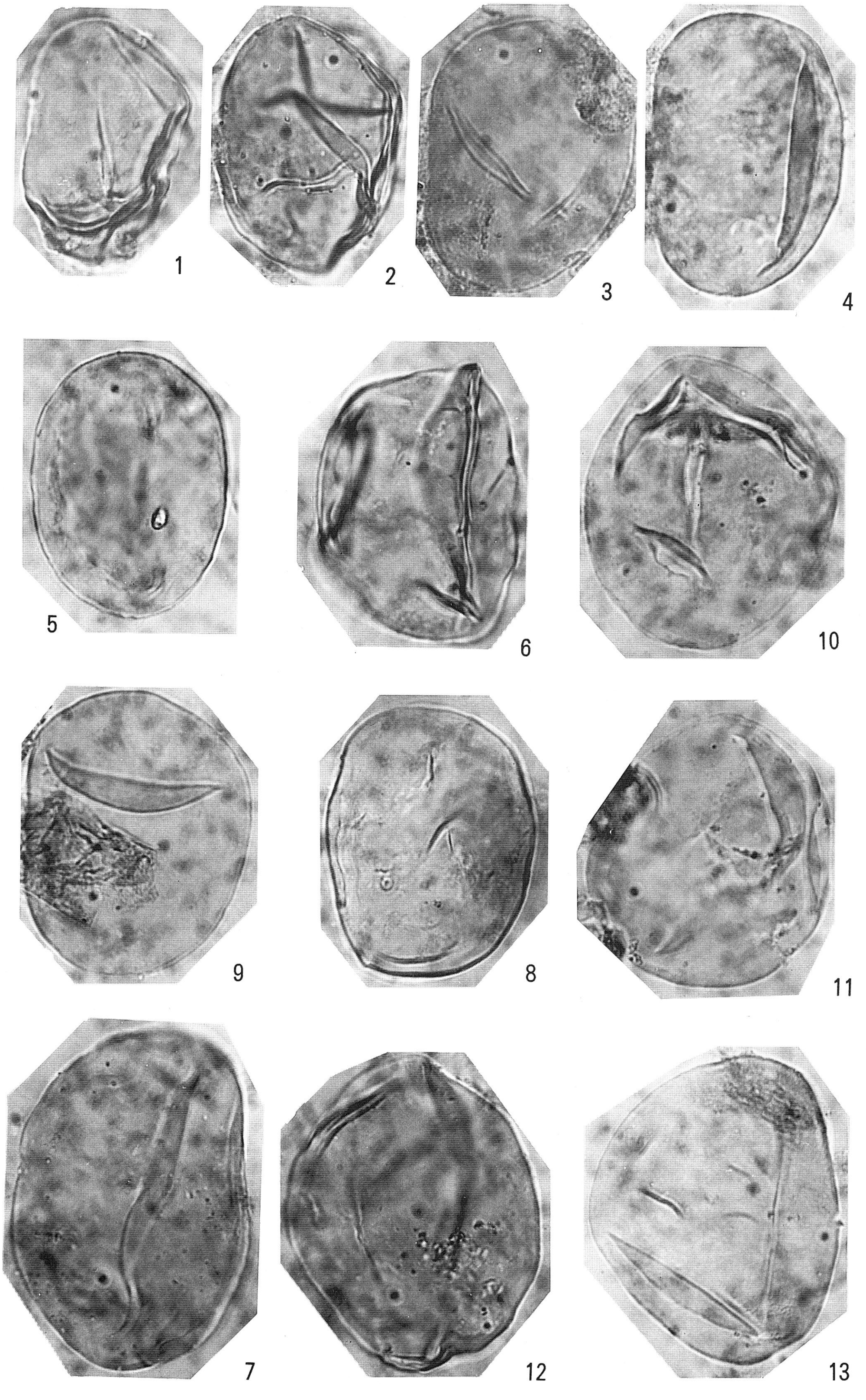


Explanation of plate 2
(All figures magnified X 1000)

Figs. 1–7. *Laevigatosporites dehiscens* Takahashi
Figs. 1, 4: GN 5412, $KM_{1,2}$ middle; figs. 2, 3: GN 5411, $KM_{1,2}$ middle; fig. 5: GN 5486, $KP_{1,2}$ upper; fig. 6: GN 5466, $KP_{1,2}$ lower; fig. 7: GN 5421 $KM_{1,2}$ upper.

Fig. 8. *Laevigatosporites undulatus* Takahashi & Jux
GN 5466. $KP_{1,2}$ lower.

Figs. 9–13. *Laevigatosporites ovoideus* Takahashi
Figs. 9, 13: GN 5412, $KM_{1,2}$ middle; fig. 10: GN 5423, $KM_{1,2}$ upper; fig. 11: GN 5422, $KM_{1,2}$ upper; fig. 12: GN 5421. $KM_{1,2}$ upper.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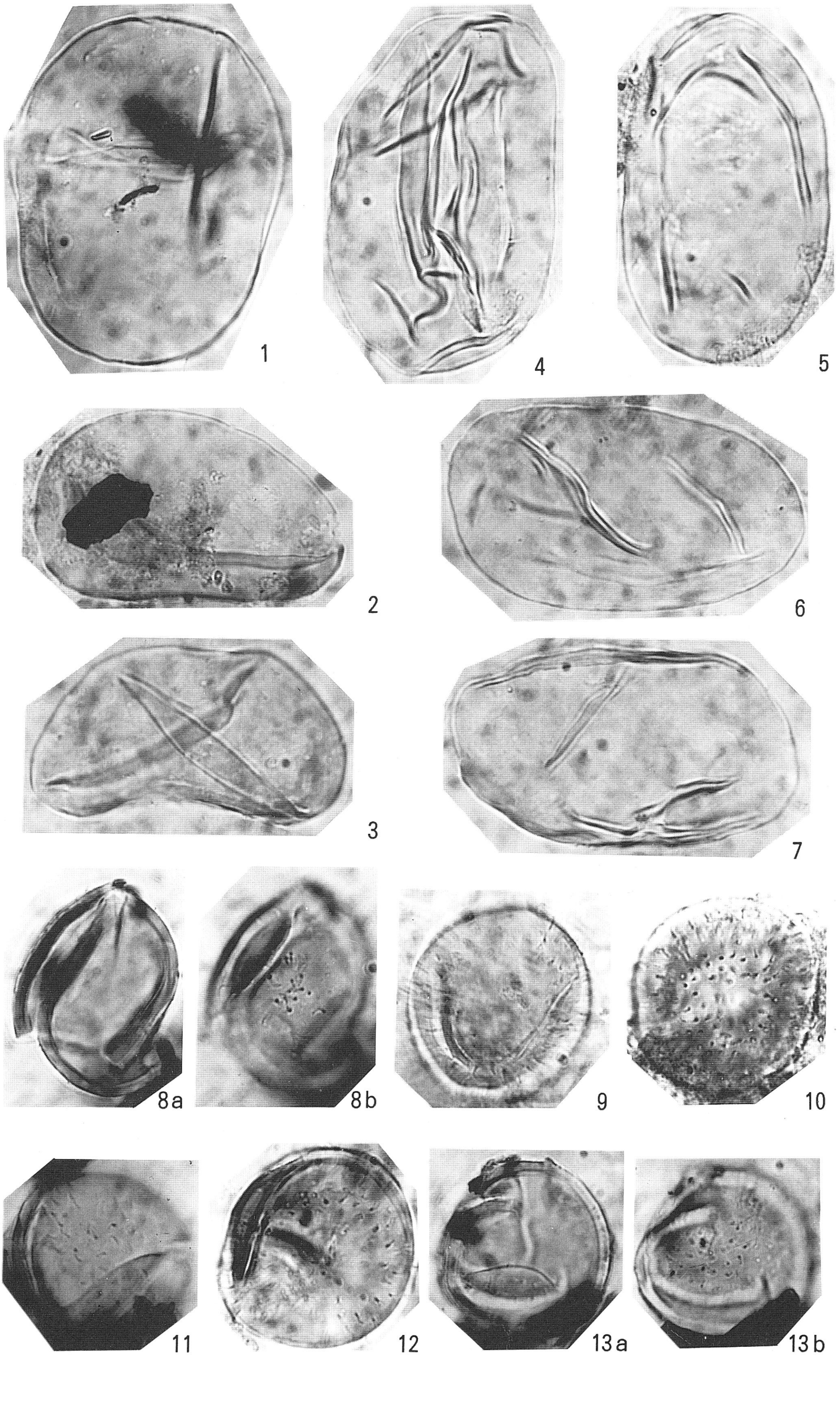
Explanation of plate 3
(All figures magnified X 1000)

Fig. 1.	*Laevigatosporites aegyptiacus* Takahashi & Jux GN 5466, $KP_{1,2}$ lower.
Figs. 2–7.	*Laevigatosporites turcicus* n. sp. Figs. 2, 3, 6: GN 5413, $KM_{1,2}$ middle; figs. 4, 5. 7: GN 5412, $KM_{1,2}$ middle; fig. 5: holotype.
Figs. 8–13.	*Monogemmites pseudosetarius* (Wayland & Pflug) Krutzsch Figs. 8a–b: GN 5452, KM_3 Kisrakdere W.; figs. 9, 10, 12: GN 5476. $KP_{1,2}$ middle; fig. 11: GN 5454, KM_3 Kisrakdere W.; figs. 13a –b: GN 5453, KM_3 Kisrakdere W.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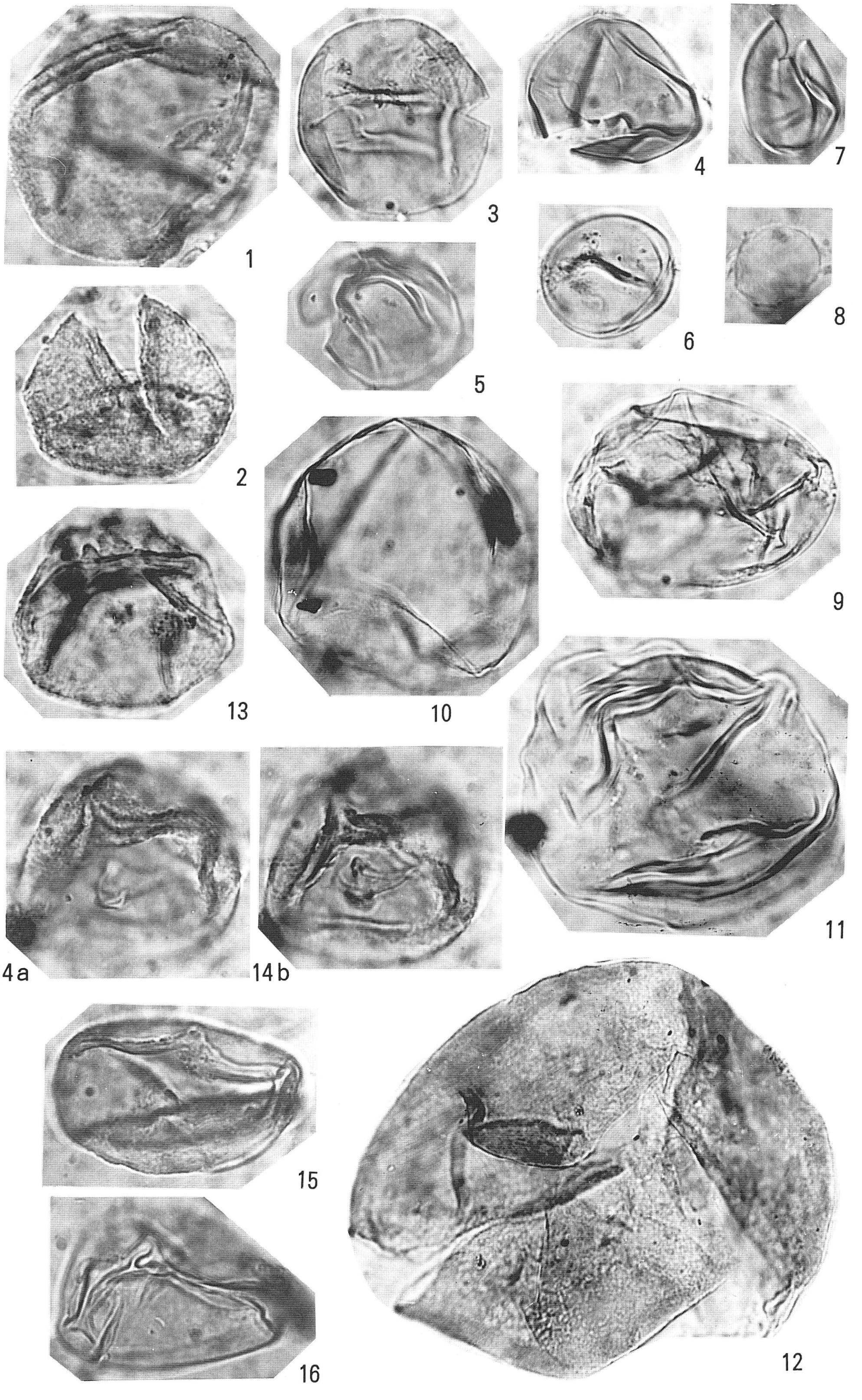
Explanation of plate 4

(All figures magnified X 1000 unless otherwise mentioned)

Figs. 1, 2.	*Inaperturopollenites dubius* (Potonié & Venitz) Thomson & Pflug GN 5401, $KM_{1,2}$ lower.
Figs. 3–6.	*Inaperturopollenites laevigatus* Takahashi Figs. 3, 6: GN 5476, $KP_{1,2}$ middle; figs. 4, 5: GN 5411, $KM_{1,2}$ middle.
Figs. 7, 8.	*Inaperturopollenites parvus* Takahashi Fig. 7: GN 5401, $KM_{1,2}$ lower; fig. 8: GN 5466, $KP_{1,2}$ lower.
Figs. 9–11.	*Psophosphaera aggereloides* (Maljavkina) Chlonova Fig. 9: GN 5486, $KP_{1,2}$ upper; fig. 10: GN 5436, KM_3 Merkez Munja; fig. 11: GN 5466, $KP_{1,2}$ lower.
Fig. 12.	*Psophosphaera pseudotsugoides* Krutzsch GN 5402, $KM_{1,2}$ lower.
Figs. 13–15.	*Sequoiapollenites gracilis* Krutzsch GN 5401, $KM_{1,2}$ lower.
Figs. 16.	*Sequoiapollenites* sp. GN 5411, $KM_{1,2}$ middle.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Explanation of plate 5

(All figures magnified X 1000)

Figs. 1a–b, 2. *Sequoiapollenites largus* (Kremp) Manum
Figs. 1a–b: GN 5401, $KM_{1,2}$ lower; fig. 2: GN 5402, $KM_{1,2}$ lower.

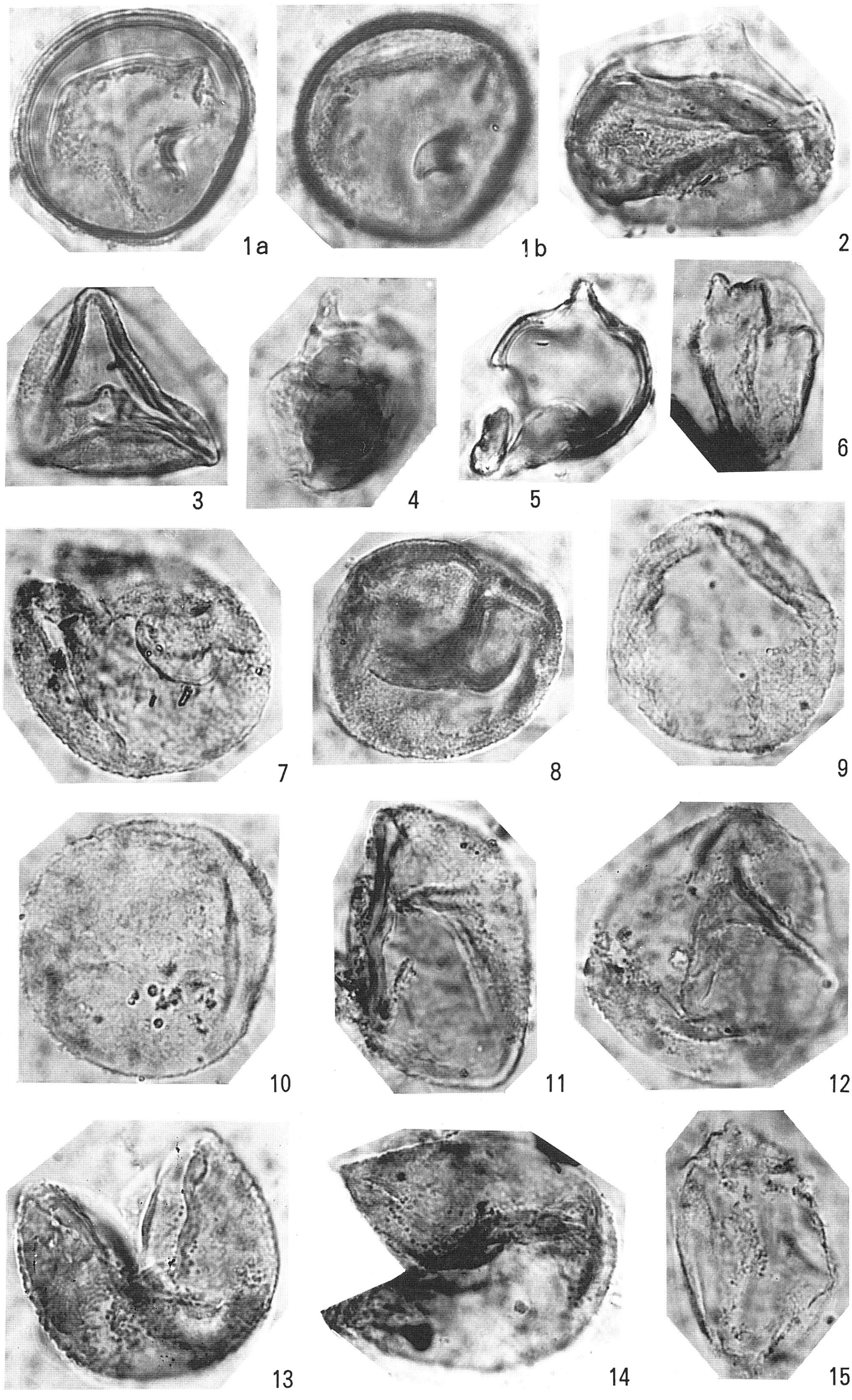
Fig. 3. *Sequoiapollenites gracilis* Krutzsch
GN 5401, $KM_{1,2}$ lower.

Figs. 4, 5. *Sequoiapollenites polyformosus* Thiergart
Fig. 4: GN 5401, $KM_{1,2}$ lower; fig. 5: GN 5436, KM_3 Merkez Munja.

Fig. 6. *Sequoiapollenites* cf. *pilaeligulus* Krutzsch
GN 5466, $KP_{1,2}$ lower.

Figs. 7–10. *Cupressacites* cf. *cuspidataeformis* (Zaklinskaja) Krutzsch
Figs. 7, 8: GN 5401, $KM_{1,2}$ lower; figs. 9, 10: GN 5421, $KM_{1,2}$ upper.

Figs. 11–15. *Cupressacites insulipapillatus* (Trevisan) Krutzsch
Figs. 11, 12, 13: GN 5401, $KM_{1,2}$ lower; fig. 14: GN 5476, $KP_{1,2}$ middle; fig. 15: GN 5466, $KP_{1,2}$ lower.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Explanation of plate 6
(All figures magnified X 1000 unless otherwise mentioned)

Fig. 1. *Monopunctites* sp.
GN 5436, KM_3 Merkez Munja.

Figs. 2a−b. *Smilacipites* sp.
GN 5477, $KP_{1,2}$ middle; fig, 2 a: X 600; fig, 2b: X 400.

Fig. 3. ?*Smilacipites* sp.
GN 5437, KM_3 Merkez Munja.

Figs. 4−7. *Potamogetonacidites difficilis* Takahashi
Figs. 4, 5: GN 5401, $KM_{1,2}$ lower; fig. 6: GN 5490, $KP_{1,2}$ upper; fig. 7: GN 5487, $KP_{1,2}$ upper.

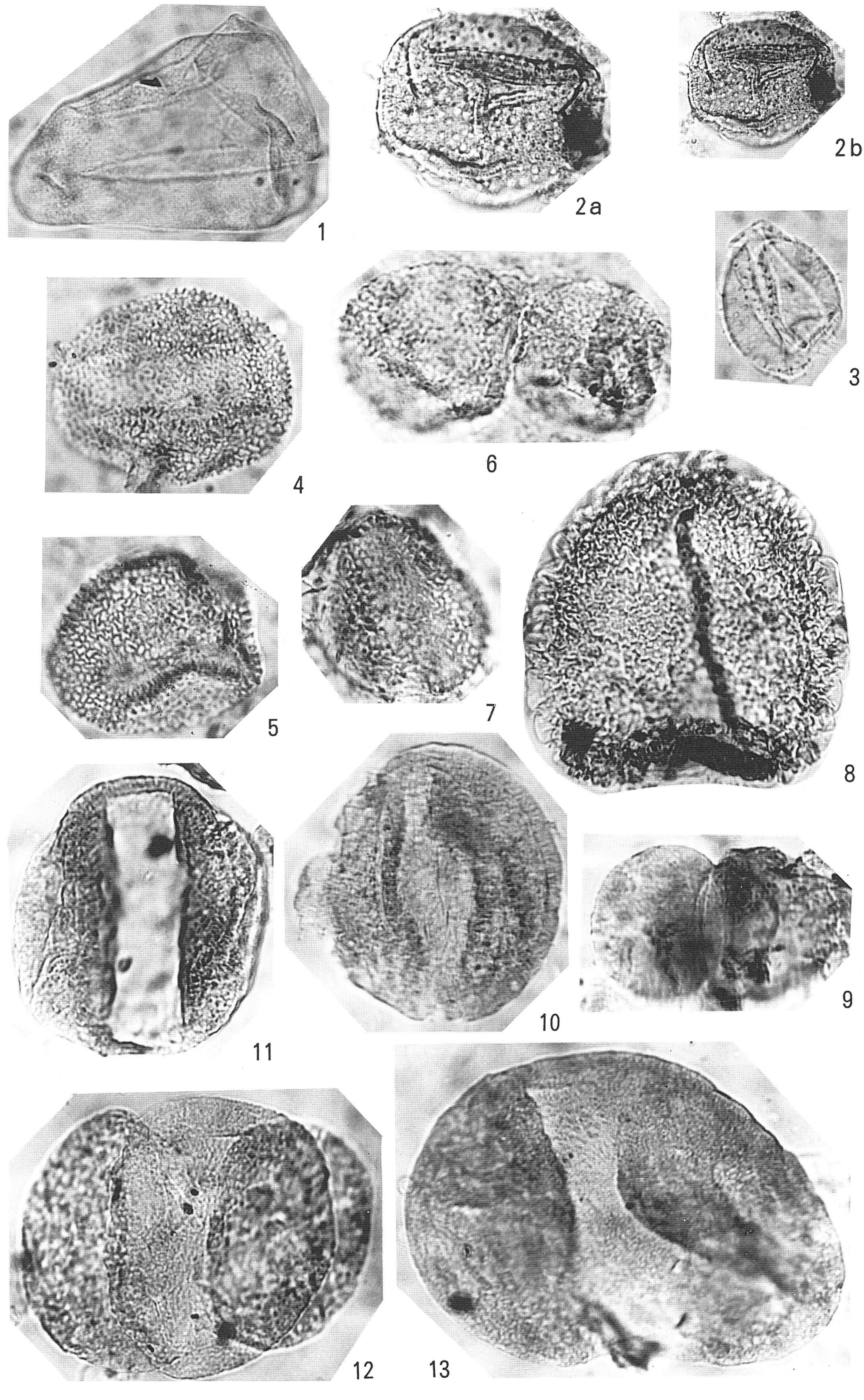
Fig. 8. *Zonalapollenites maximus* (Raatz) Krutzsch
GN 5401, $KM_{1,2}$ lower, X 600.

Fig. 9. *Podocarpidites podocarpoides* (Thiergart) Krutzsch
GN 5490, $KP_{1,2}$ upper; X 600.

Figs. 10, 11. *Cedripites anatolicus* n. sp.
Fig. 10: GN 5421, $KM_{1,2}$ lower; fig. 11: holotype, GN 5401, $KM_{1,2}$ lower; X 600.

Fig. 12. *Pityosporites labdacus* (Potonié) Thomson & Pflug subsp. *maximus* (Potonié) n. comb.
GN 5401, $KM_{1,2}$ lower; X 600.

Fig. 13. *Piceapollis planoides* Krutzsch
GN 5401, $KM_{1,2}$ lower; X 600.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Explanation of plate 7

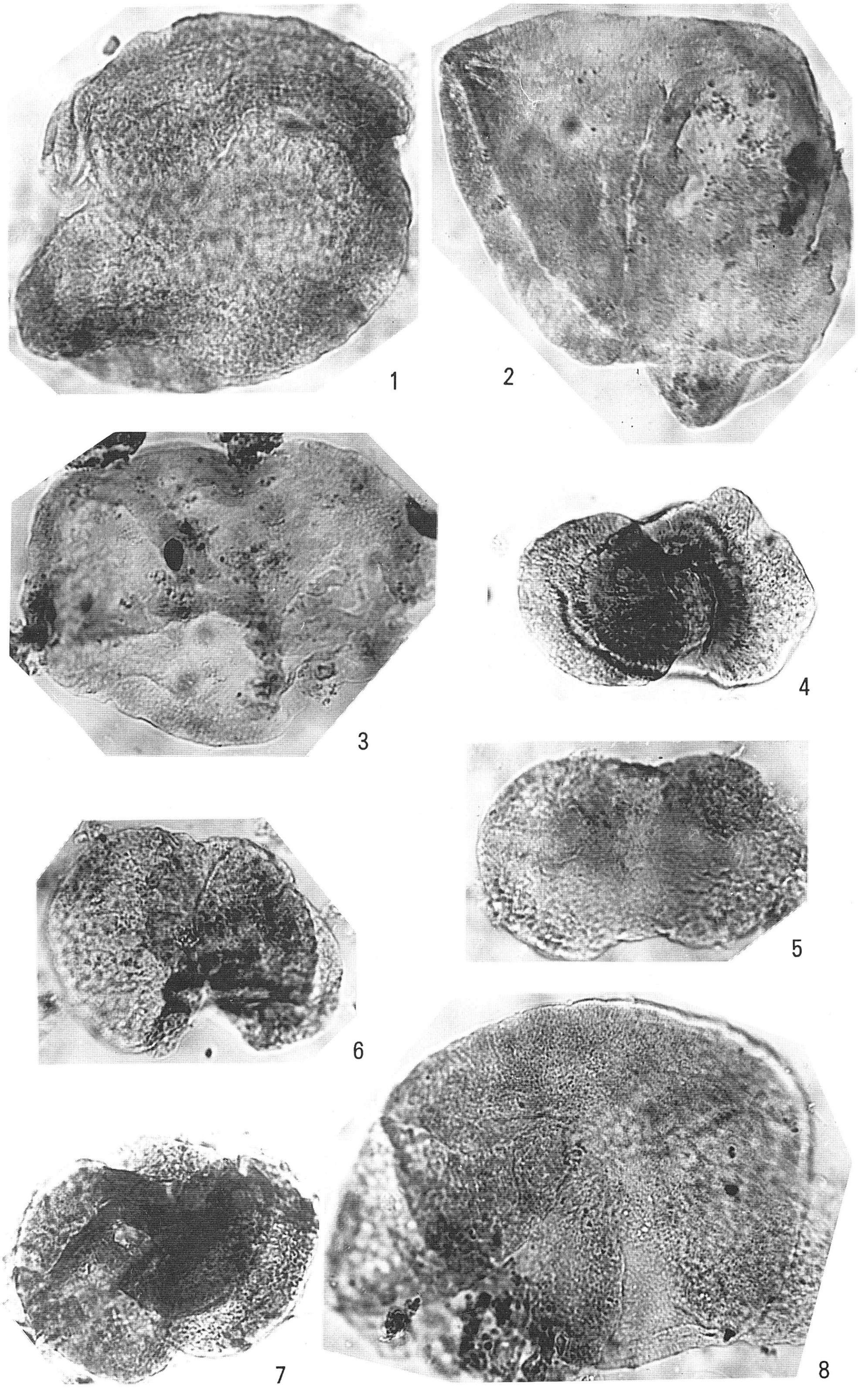
(All figures magnified X 600)

Figs. 1–3, 8. *Piceapollis tobolicus* (Panova) Krutzsch
Fig. 1: cf., GN 5412, $KM_{1,2}$ middle; fig. 2: cf., GN 5423, $KM_{1,2}$ upper; fig. 3: cf., GN 5421, $KM_{1,2}$ upper; fig. 8: GN 5422, $KM_{1,2}$ upper.

Fig. 4. *Podocarpidites verrucorpus* Wu
GN 5401, $KM_{1,2}$ lower.

Fig. 5. *Podocarpidites nageiaformis* (Zaklinskaja) Krutzsch
GN 5489, $KP_{1,2}$ middle.

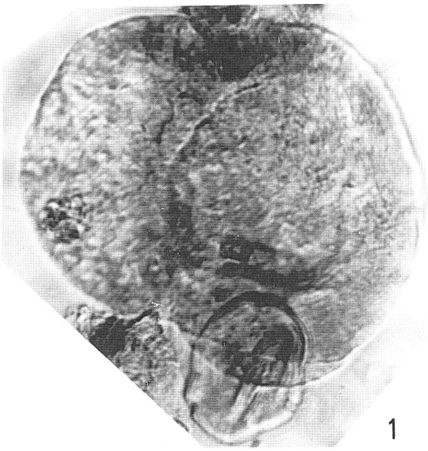
Figs. 6, 7. *Podocarpidites andiniformis* (Zaklinskaja) Krutzsch
GN 5477, $KP_{1,2}$ middle.



Explanation of plate 8

(All figures magnified X 600)

Figs. 1—4.	*Abiespollenites* cf. *absolutus* Thiergart Figs. 1. 4: GN 5401, $KM_{1,2}$ lower; fig. 2: GN 5411, $KM_{1,2}$ middle; fig. 3: GN 5476, $KP_{1,2}$ middle.
Figs. 5, 7.	*Piceapollis* cf. *sacculiferoides* Krutzsch Fig. 5: GN 5476, $KP_{1,2}$ middle; fig. 7: GN 5421, $KM_{1,2}$ upper.
Fig. 6.	?*Podocarpidites* sp. GN 5436, KM_3 Merkez Munja.
Fig. 8.	*Pityosporites labdacus* (Potonié) Thomson & Pflug *labdacus* GN 5423, $KM_{1,2}$ upper.
Fig. 9.	*Piceapollis* cf. *praemarianus* Krutzsch GN 5412, $KM_{1,2}$ middle.



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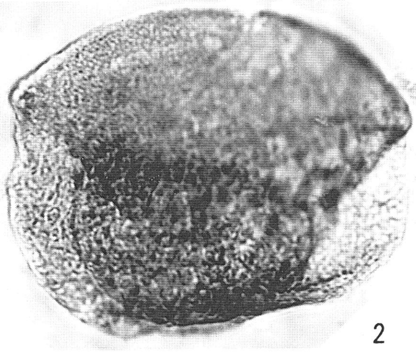

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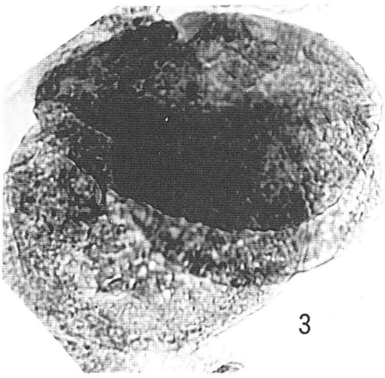

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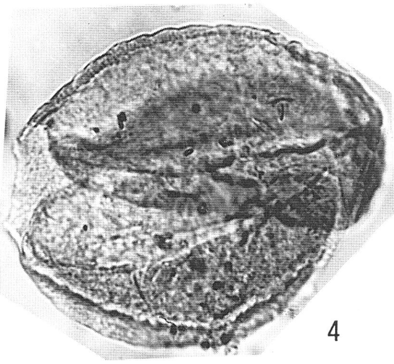

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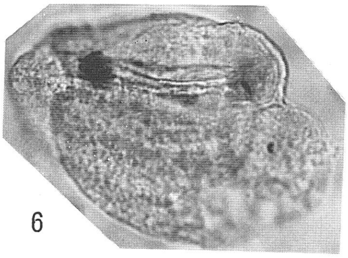

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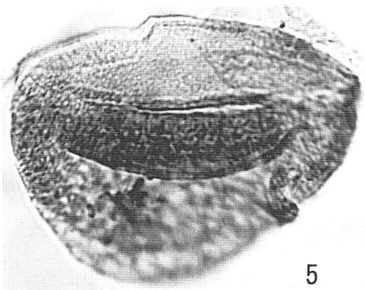

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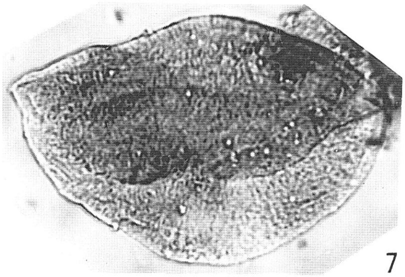

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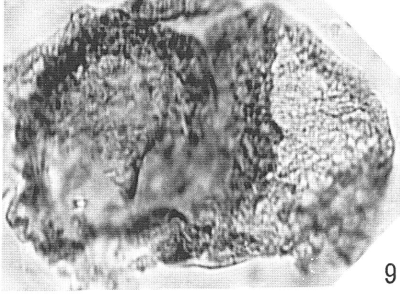

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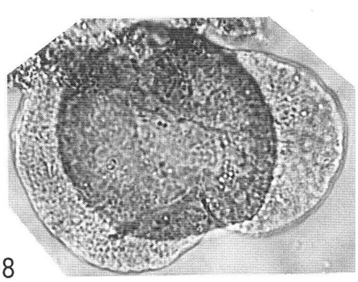

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Explanation of plate 9

(All figures magnified X 600 unless otherwise mentioned)

Figs. 1a–b. *Abiespollenites microsaccoides* Krutzsch
GN 5401, $KM_{1,2}$ lower.

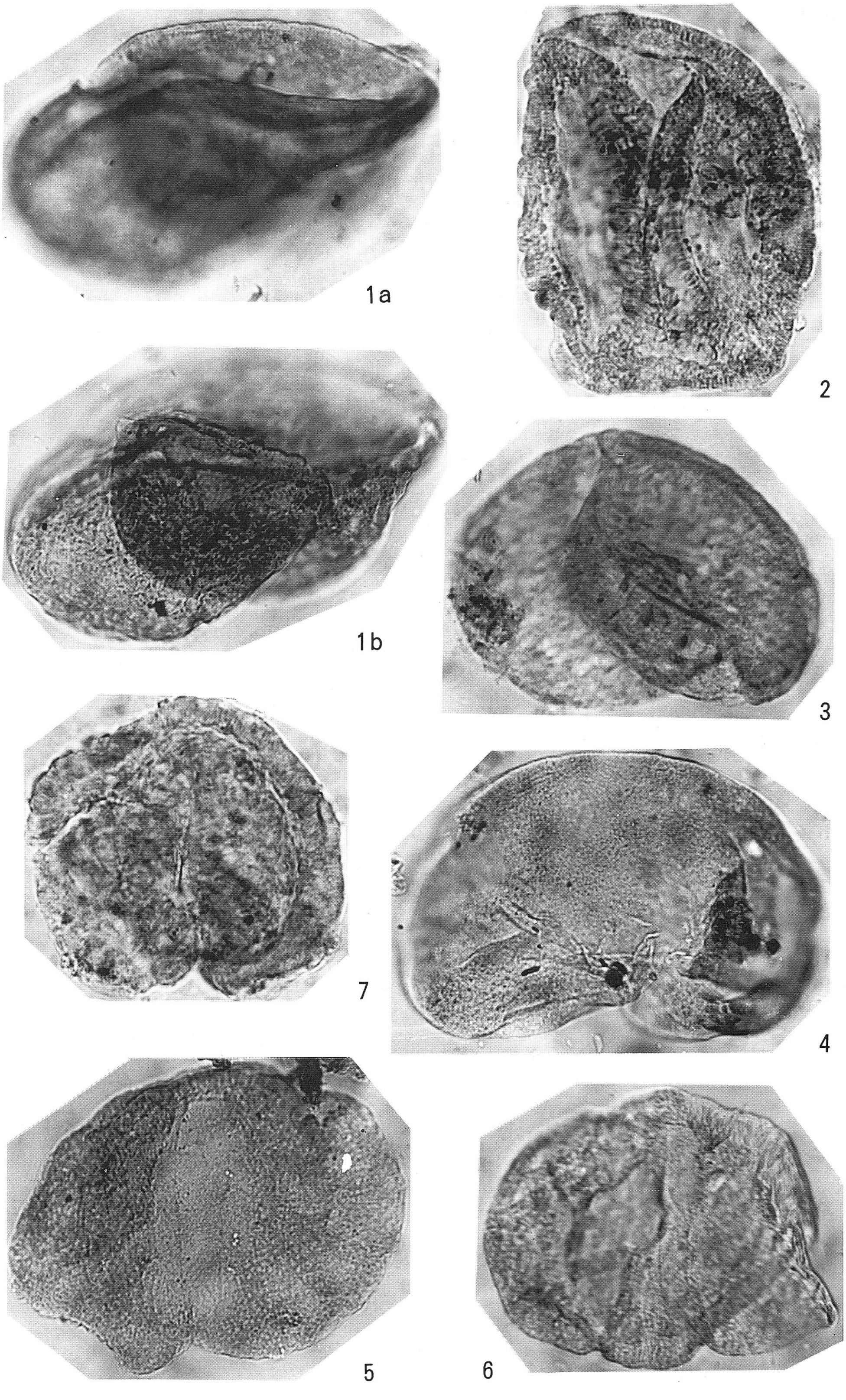
Fig. 2. *Cedripites szaszvarensis* Nagy
GN 5422, $KM_{1,2}$ upper, X 1000.

Figs. 3, 6. *Abiespollenites absolutus* Thiergart
Fig. 3: cf. , GN 5401, $KM_{1,2}$ lower; fig. 6: GN 5421, $KM_{1,2}$ upper.

Fig. 4. *Piceapollis neogenicus* (Nagy) n. comb.
GN 5401, $KM_{1,2}$ lower.

Fig. 5. ?*Abiespollenites minor* (Chlonova) Krutzsch
GN 5422, $KM_{1,2}$ upper.

Fig. 7. ?*Cedripites* sp.
GN 5421, $KM_{1,2}$ upper, X 1000.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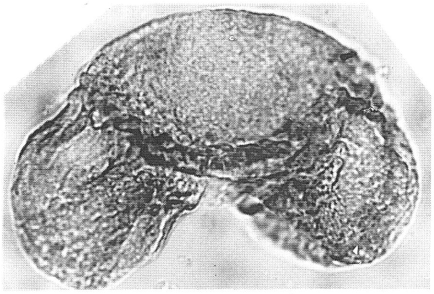
Explanation of plate 10
(All figures magnified X 600)

Figs. 1, 2.	*Pityosporites miocaenicus* (Nagy) n. comb. Fig. 1: GN 5402, $KM_{1,2}$ lower; fig. 2: GN 5401, $KM_{1,2}$ lower.
Figs. 3, 4.	*Cedripites pseudodeodaraeformis* n. sp. Fig. 3: holotype, GN 5401, $KM_{1,2}$ lower; fig. 4: GN 5466, $KP_{1,2}$ lower.
Fig. 5.	*Pityosporites baileyanus* (Traverse) n. comb. GN 5486, $KP_{1,2}$ upper.
Figs. 6, 7.	*Pityosporites macroinsignis* Krutzsch Fig. 6: GN 5486, $KP_{1,2}$ upper; fig. 7: GN 5401, $KM_{1,2}$ lower.
Figs. 8, 9.	*Piceapollis anatoliensis* n. sp. Fig. 8.: holotype, GN 5422, $KM_{1,2}$ upper; fig. 9 GN 5423, $KM_{1,2}$ upper.



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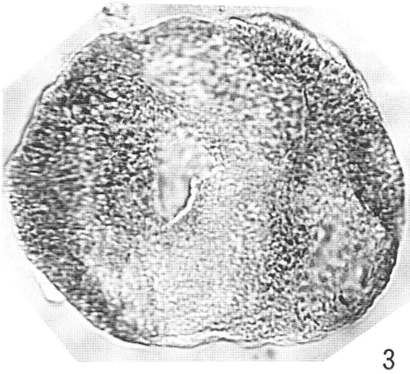

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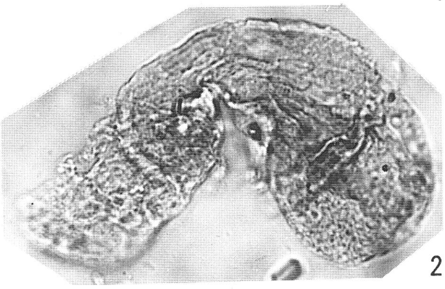

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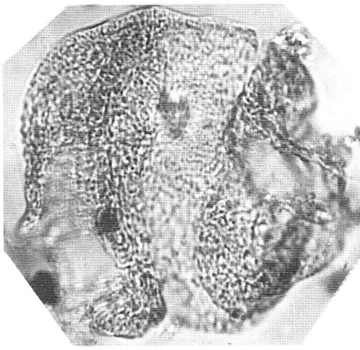

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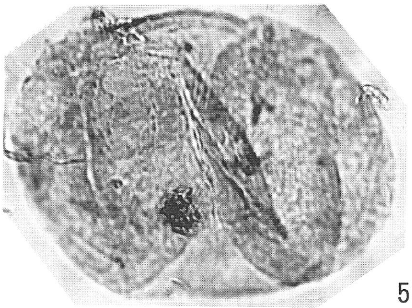

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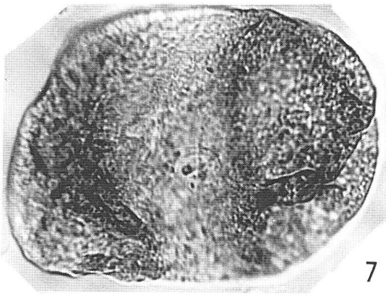

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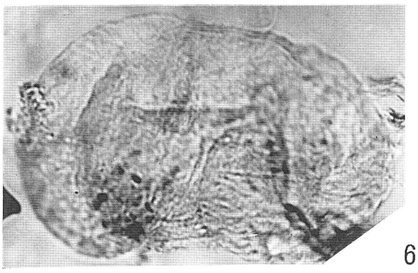

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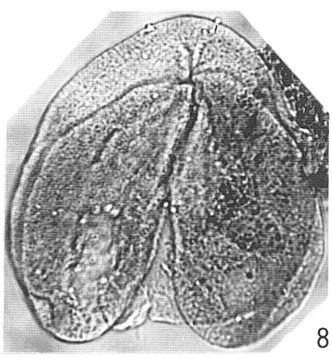

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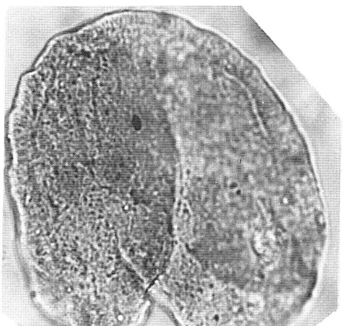

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Explanation of plate 11

(All figures magnified X 1000 unless otherwise mentioned)

Fig. 1. *Pityosporites aralicus* (Bolkhovitina) Krutzsch
GN 5486, $KP_{1,2}$ upper, X 600.

Figs. 2, 4, 5. *Piceapollis minor* n. sp.
Fig. 2: GN 5401, $KM_{1,2}$ lower; figs. 4, 5: GN 5421, $KM_{1,2}$ upper; fig. 5: holotype; X 600.

Fig. 3. *Cedripites miocaenicus* Krutzsch
GN 5401, $KM_{1,2}$ lower, X 600.

Figs. 6, 8. *Piceapollis* sp.
GN 5421, $KM_{1,2}$ upper, X 600.

Fig. 7. *Pityosporites* cf. *pristinipollinius* (Traverse) Krutzsch
GN 5476, $KP_{1,2}$ middle, X 600.

Fig. 9. *Piceapollis paraemarianus* Krutzsch
GN 5422, $KM_{1,2}$ upper, X 600.

Fig. 10. *Cycadopites* sp.
GN 5452, KM_3 Kisrakdere W.

Figs. 11, 13, 14. *Monocolpopollenites kyushuensis* Takahashi
GN 5436, KM_3 Merkez Munja.

Fig. 12. *Monocolpopollenites intrabaculatus* Takahashi
GN 5476, $KP_{1,2}$ middle.

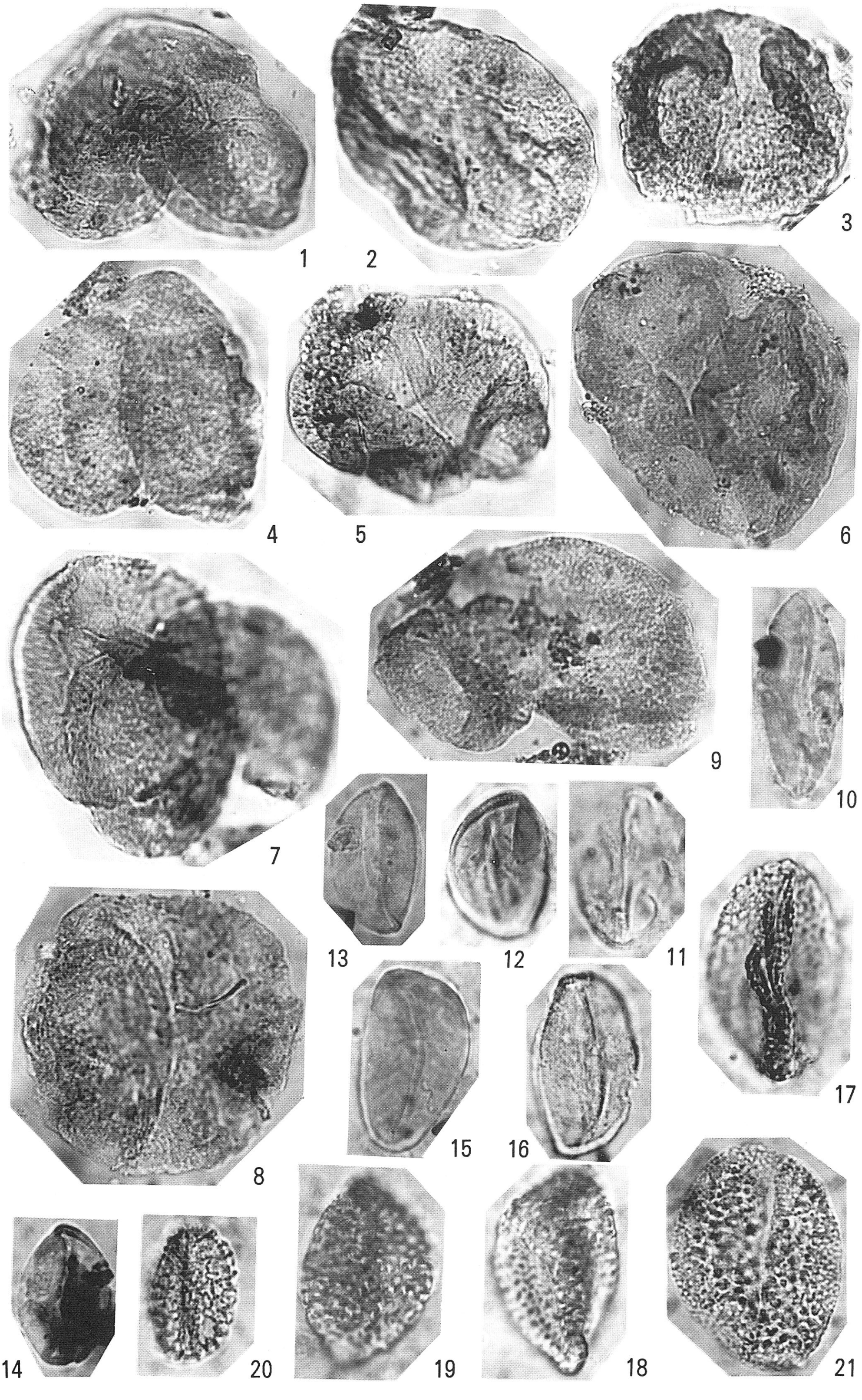
Figs. 15, 16. *Monocolpopollenites tranquillus* (Pot.) Thomson & Pflug
Fig. 15: GN 5413, $KM_{1,2}$ middle; fig. 16: GN 5436, KM_3 Merkez Munja.

Fig. 17. *Arecipites pflugii* (Takahashi) Krutzsch
GN 5476, $KP_{1,2}$ middle.

Figs. 18, 19. *Arecipites brandenburgensis* Krutzsch
Fig. 18: GN 5401, $KM_{1,2}$ lower; fig. 19: GN 5402, $KM_{1,2}$ lower.

Fig. 20. *Arecipites* sp.
GN 5401, $KM_{1,2}$ lower.

Fig. 21. *Monosulcites* sp.
GN 5401, $KM_{1,2}$ lower.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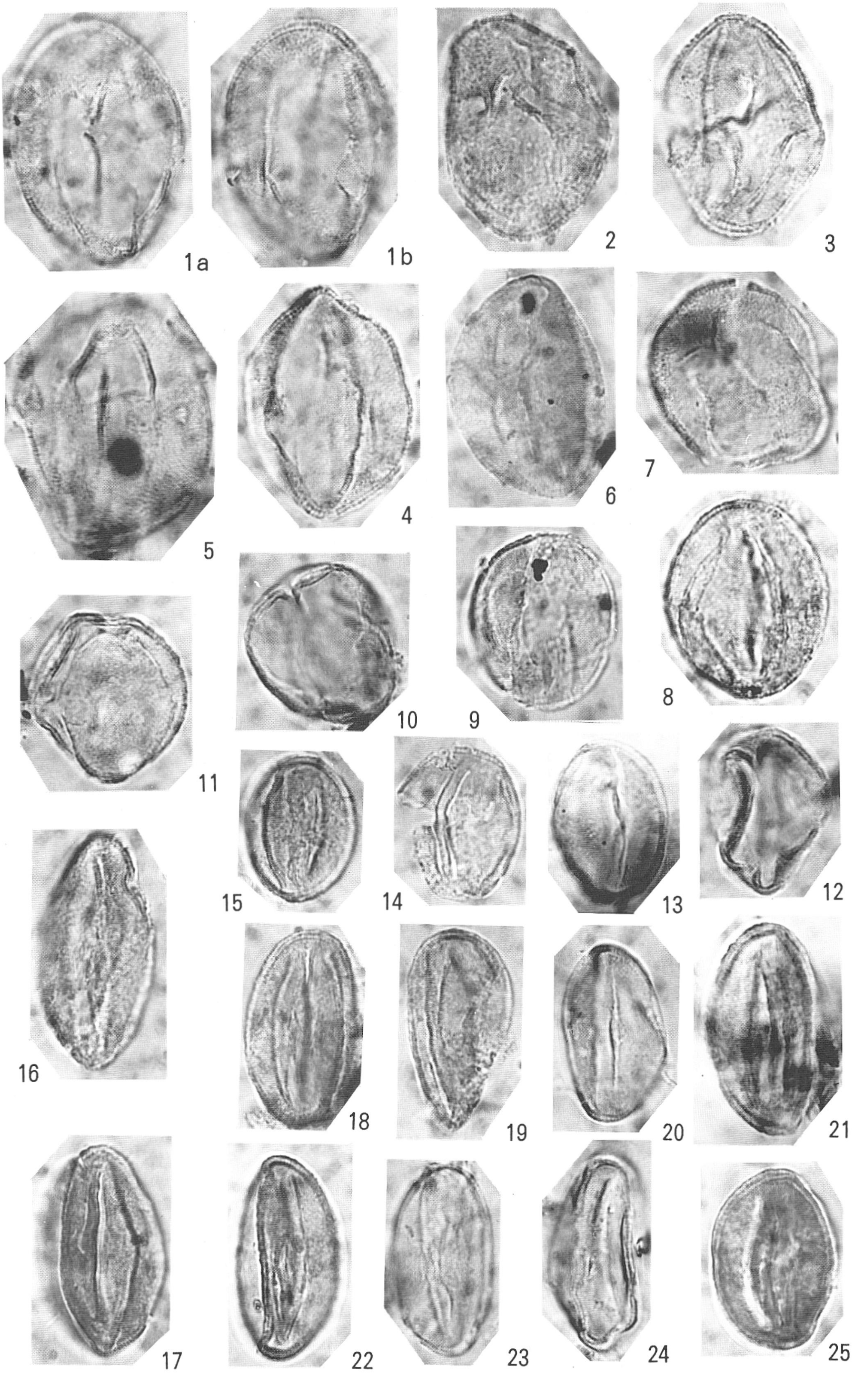
Explanation of plate 12
(All figures magnified X 1000)

Figs. 1−6.	*Quercoidites somaensis* n. sp. Figs. 1−5: GN 5466, $KP_{1,2}$ lower; fig. 6: GN 5452, KM_3 Kisrakdere W.; figs. 1a −b: holotype.
Figs. 7−11.	*Quercoidites densus* (Pflug) Song & Zheng Figs. 7, 10, 11: GN 5466, $KP_{1,2}$ lower; fig. 8: GN 5476, $KP_{1,2}$ middle; fig. 9: GN 5436, KM_3 Merkez Munja
Figs. 12−15.	*Quercoidites microdensus* Takahashi & Jux Fig. 12: GN 5466, $KP_{1,2}$ lower; fig. 13: GN 5476, $KP_{1,2}$ middle; fig. 14: GN 5411, $KM_{1,2}$ middle; fig. 15: GN 5486, $KP_{1,2}$ upper.
Figs. 16−24.	*Quercoidites henrici* (Potonié) Potonié Figs. 16, 20, 23, 24: GN 5466, $KP_{1,2}$ lower; figs. 17, 19, 22: GN 5401, $KM_{1,2}$ lower; fig. 18: GN 5411, $KM_{1,2}$ middle; fig. 21: GN 5476, $KP_{1,2}$ middle.
Fig. 25.	*Quercoidites* cf. *punctatus* Takahashi & Jux GN 5401, $KM_{1,2}$ lower.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Explanation of plate 13

(All figures magnified X 1000)

Figs. 1–6. *Quercoidites microhenrici* (Potonié) Potonié
Figs. 1, 6: GN 5411, $KM_{1,2}$ middle; fig. 2: GN 5422, $KM_{1,2}$ upper; figs. 3, 4: GN 5466, $KP_{1,2}$ lower; fig. 5: GN 5402. $KM_{1,2}$ lower.

Figs. 7–10. *Cupuliferoidaepollenites fallax* (Potonié) Potonié
Fig. 7: GN 5466, $KP_{1,2}$ lower; Fig. 8: GN 5486, $KP_{1,2}$ upper; fig. 9: GN 5401, $KM_{1,2}$ lower; fig. 10: GN 5436, KM_3 Merkez Munja.

Figs. 11, 12. *Cupuliferoidaepollenites facetus* (Takahashi) Takahashi
Fig. 11: GN 5436, KM_3 Merkez Munja; fig. 12: GN 5401, $KM_{1,2}$ lower.

Fig. 13. *Cupuliferoidaepollenites weylandii* (Takahashi) Takahashi
GN 5466, $KP_{1,2}$ lower.

Figs. 14, 15. *Cupuliferoidaepollenites longus* n. sp.
Fig. 14: holotype; GN 5466, $KP_{1,2}$ lower.

Figs. 16–21. *Cupuliferoidaepollenites vulgaris* (Takahashi) Takahashi
Fig. 16, 21: GN 5436, KM_3 Merkez Munja; fig. 17: GN 5422, $KM_{1,2}$ upper; fig. 18: GN 5466, $KP_{1,2}$ lower; fig. 19: GN 5486, $KP_{1,2}$ lower; fig. 20: GN 5401. $KM_{1,2}$ lower.

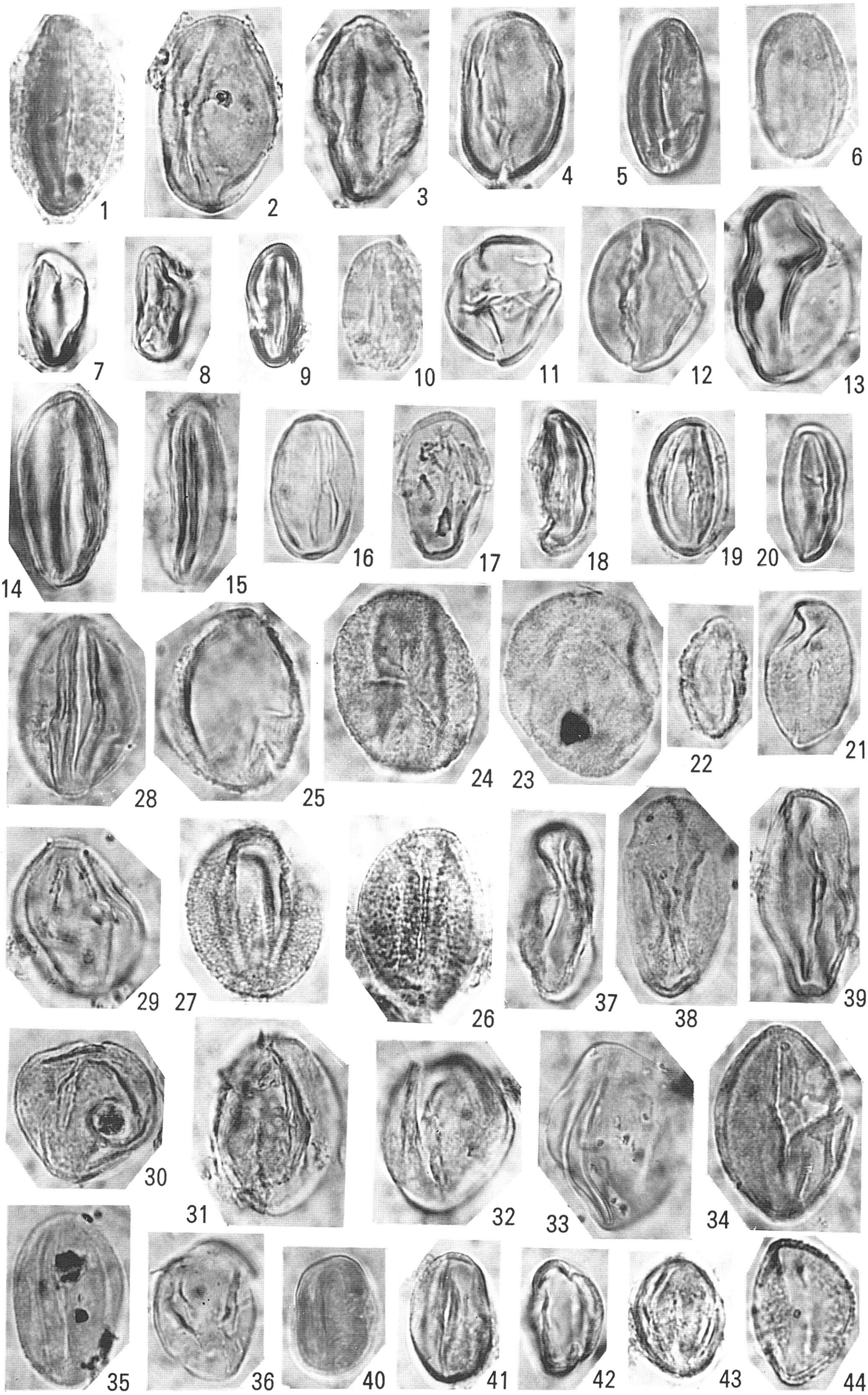
Figs. 22, 44. *Tricolpopollenites* sp. a
Fig. 22: GN 5466, $KP_{1,2}$ lower; fig. 44: GN 5421, $KM_{1,2}$ upper.

Figs. 23–27. *Tricolpopollenites anatolicus* n. sp.
Fig. 23: GN 5436, KM_3 Merkez Munja; fig. 24: GN 5402, $KM_{1,2}$ lower; figs. 25,27: GN 5466, $KP_{1,2}$ lower; fig. 26: holotype, GN 5476, $KP_{1,2}$ upper.

Figs. 28–36. *Tricolpopollenites chagrenatus* Takahashi & Jux
Figs. 28, 29, 33, 36: GN 5421, $KM_{1,2}$ upper; figs. 30, 31: GN 5486, $KP_{1,2}$ upper; fig. 32: GN 5489, $KP_{1,2}$ upper; fig. 34: GN 5401, $KM_{1,2}$ lower; fig. 35: GN 5452, KM_3 Kisrakdere W.

Figs. 37–39. *Quercoidites microhenrici* (Potonié) Potonié
GN 5466, $KP_{1,2}$ lower.

Figs. 40–43. *Tricolpopollenites pseudoasper* Takahashi & Jux
Fig. 40: GN 5401, $KM_{1,2}$ lower; fig. 41: GN 5412, $KM_{1,2}$ middle; fig. 42: GN 5466, $KP_{1,2}$ lower; fig. 43: GN 5486, $KP_{1,2}$ upper.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Explanation of plate 14

(All figures magnified X 1000)

Figs. 1–7. *Cupuliferoidaepollenites vulgaris* (Takahashi) Takahashi
Fig. 1: GN 5466, $KP_{1,2}$ lower; fig. 2: GN 5451, KM_3 Kisrakdere W.; figs.3,6: GN 5421, $KM_{1,2}$ upper; fig.4:5452, KM_3 Kisrakdere W.; fig. 5: GN 5422, $KM_{1,2}$ upper; fig. 7: GN 5412, $KM_{1,2}$ middle.

Figs. 8–13. *Tricolpopollenites asper* Pflug & Thomson
FIgs. 8a–b: GN 5490, $KP_{1,2}$ upper; fig. 9: GN 5401, $KM_{1,2}$ lower; fig. 10: GN 5411, $KM_{1,2}$ middle; figs. 11, 13: GN 5466, $KP_{1,2}$ lower; fig. 12: GN 5451, KM_3 Kisrakdere W.

Fig. 14. *Tricolpopollenites robusteus* (Song, Li & Zhong) n. comb.
GN 5421, $KM_{1,2}$ upper.

Figs. 15a –b. *Tricolpites rudis* (Takahashi) Takahashi & Sugiyama
GN 5466, $KP_{1,2}$ lower.

Figs. 16a –b, 19. *Tricolpites tecturatus* n. sp.
Figs. 16a –b: holotype, GN 5466, $KP_{1,2}$ lower; fig. 19: GN 5476, $KP_{1,2}$ middle.

Fig. 17. *Tricolpites minutireticulosus* Takahashi
GN 5401, $KM_{1,2}$ lower.

Fig. 18. *Tricolpites retiformis* (Pflug & Thomson) Takahashi & Jux
GN 5466, $KP_{1,2}$ lower.

Fig. 20. *Retitrescolpites* sp. a
GN 5451, KM_3 Kisrakdere W.

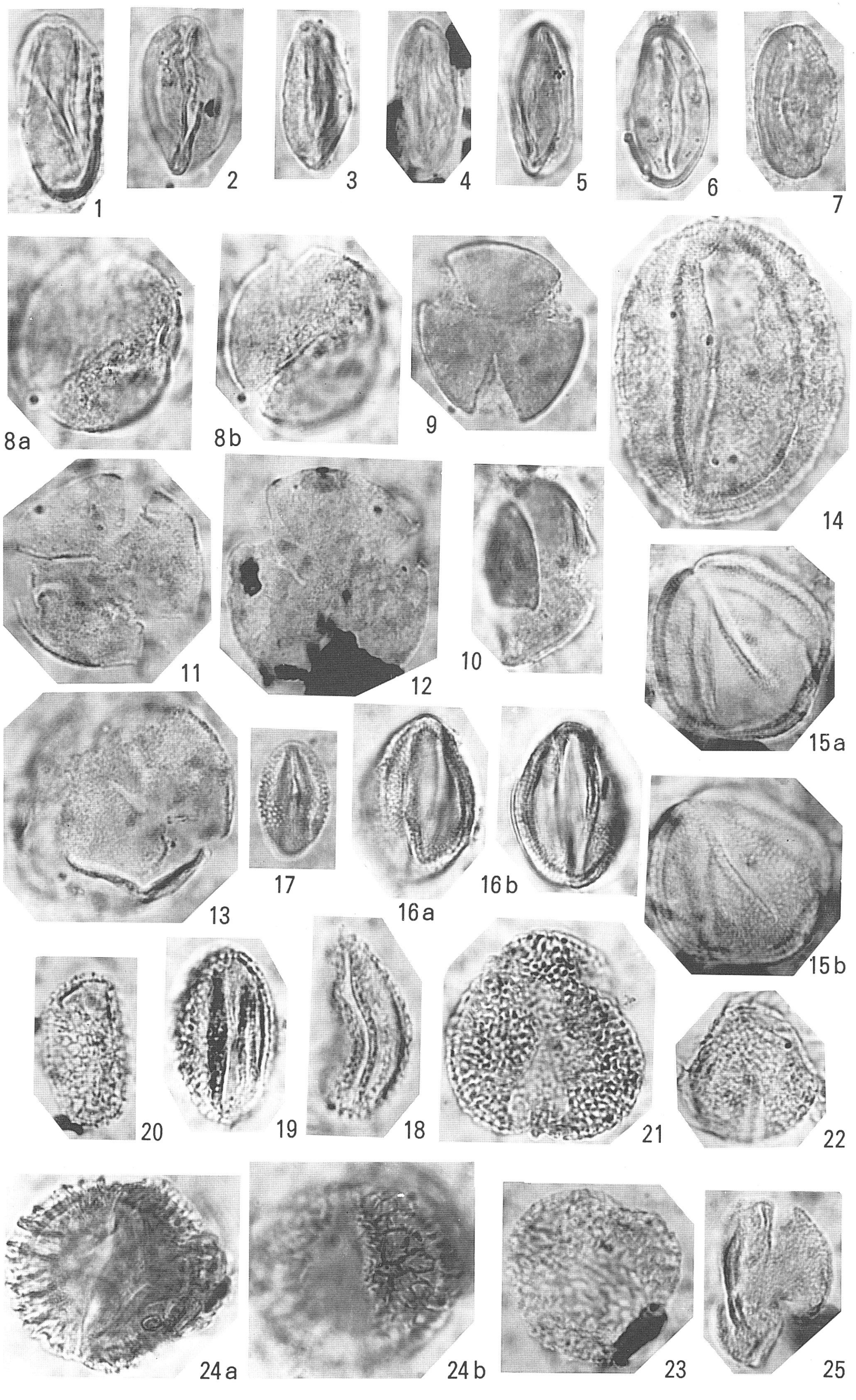
Fig. 21. *Tricolpites* sp. a
GN 5476, $KP_{1,2}$ middle.

Fig. 22. *Tricolpites* sp. b
GN 5486, $KP_{1,2}$ upper.

Fig. 23. *Retitrescolpites* sp. b
GN 5451, $KM_{1,2}$ Kisrakdere W.

Figs. 24a –b. *Retitrescolpites globosus* n. sp.
GN 5401, $KM_{1,2}$ lower.

Fig. 25. *Striatopollis circularis* n. sp.
GN 5466, $KP_{1,2}$ lower.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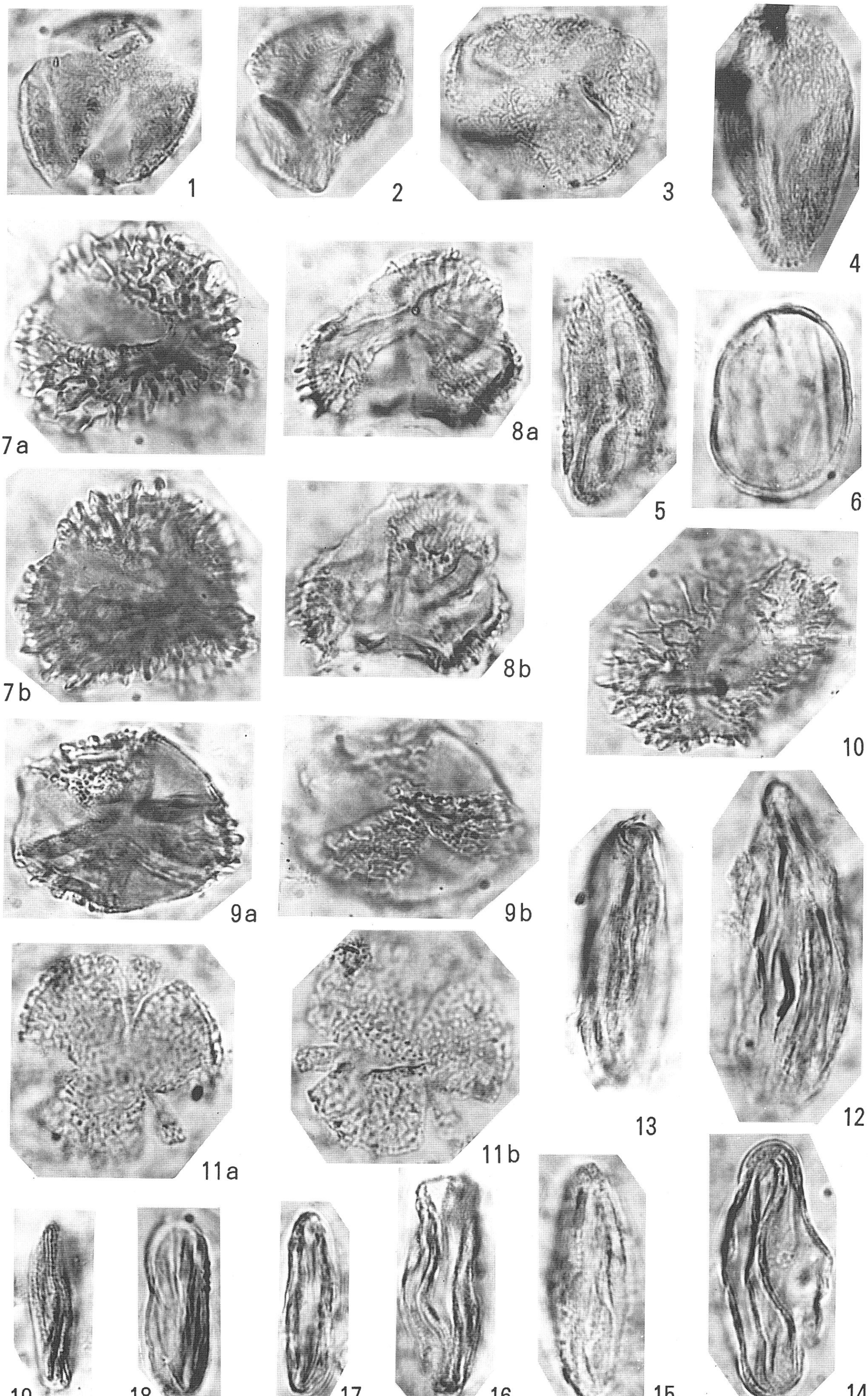
Explanation of plate 15
(All figures magnified X 1000)

Figs. 1−3.	*Striatopollis circularis* n. sp. Figs. 1, 2: GN 5401, $KM_{1,2}$ lower; fig. 1: holotype; fig. 3: GN 5466, $KP_{1,2}$ lower.
Figs. 4, 5.	*Striatopollis* sp. GN 5466, $KP_{1,2}$ lower.
Fig. 6.	*Tetracolpites* sp. GN 5476, $KP_{1,2}$ middle.
Figs. 7−10.	*Retitrescolpites globosus* n. sp. Figs. 7a−b, 10: GN 5402, $KM_{1,2}$ lower; figs. 7a −b: holotype; figs. 8a −b,9a −b: GN 5401. $KM_{1,2}$ lower.
Figs. 11a −b.	*Ranunculacidites* sp. GN 5466, $KP_{1,2}$ lower.
Figs. 12, 13.	*Ephedripites* (*Ephedripites*) *hungaricus* Nagy Fig. 12: GN 5466, $KP_{1,2}$ lower; fig. 13:5476, $KP_{1,2}$ middle.
Figs. 14−16.	*Ephedripites* (*Ephedripites*) *anatolicus* n. sp. Fig. 14: holotype, GN 5466, $KP_{1,2}$ lower; figs. 15, 16: GN 5476, $KP_{1,2}$ middle.
Figs. 17−19.	*Ephedripites* (*Ephedripites*) *minor* n. sp. Figs. 17, 19: GN 5476, $KP_{1,2}$ middle; fig. 17: holotype; fig. 18: GN 5421, $KM_{1,2}$ upper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Explanation of plate 16
(All figures magnified X 1000)

Figs. 1–4, 12–16, 23. *Intrabaculitricolporites consularis* (Takahashi) Takahashi & Jux *consularis*
Figs. 1, 13, 15: GN 5401, $KM_{1,2}$ lower; figs. 2–4, 14: GN 5466, $KP_{1,2}$ lowwer; fig. 12: GN 5476, $KP_{1,2}$ middle; fig. 16: GN 5452, KM_3 Kisrakdere W.; fig. 23: cf., GN 5437, KM_3 Merkez Munja.

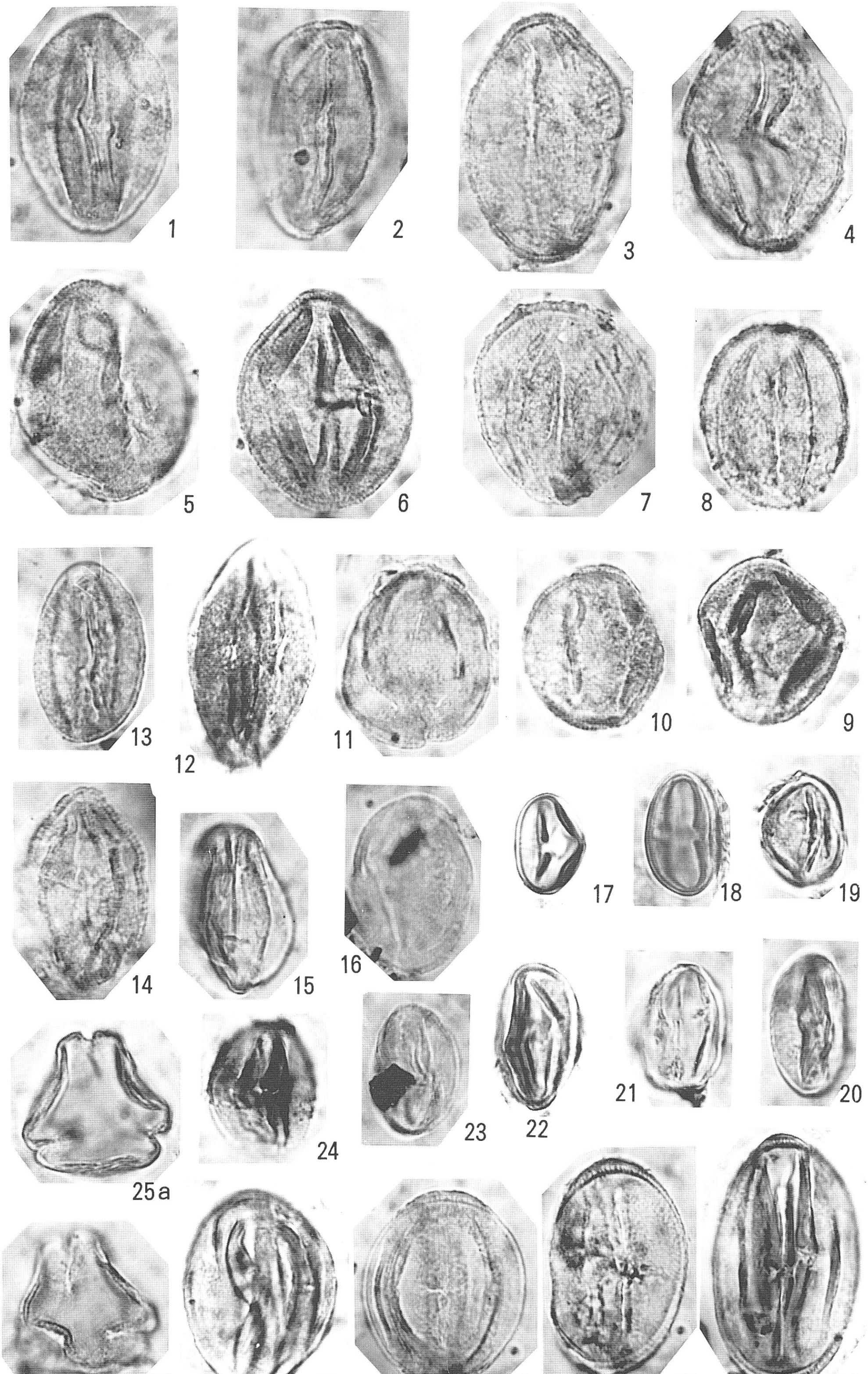
Figs. 5, 8. *Intrabaculitricolporites consularis* (Takahashi) Takahashi & Jux *globularis* (Takahashi) Takahashi & Jux
GN 5476, $KP_{1,2}$ middle.

Figs. 6, 7, 9–11. *Nyssapollenites kruschi* (Potonié) Nagy
Figs. 6, 9–11: GN 5476, $KP_{1,2}$ middle; fig. 7: GN 5466, $KP_{1,2}$ upper.

Figs. 17–22, 24. *Cupuliferoipollenites pusillus* (Potonié) Potonié
Figs. 17, 22: GN 5476, $KP_{1,2}$ middle; figs. 19, 21, GN 5488, $KP_{1,2}$ upper; fig. 18: GN 5412, $KM_{1,2}$ middle; fig. 20: GN 5402, $KM_{1,2}$ lower; fig. 24: GN 5476, $KP_{1,2}$ middle, cf.

Figs. 25a –b. *Nyssapollenites kruschi* (Potonié) Nagy asp. *pseudolaesus* (Potonié) n. comb.
GN 5466, $KP_{1,2}$ lower.

Figs. 26–29. *Tricolporopollenites turcianus* n. sp.
Figs. 26, 28: GN 5477, $KP_{1,2}$ middle; fig. 26: holotype; fig. 27: GN 5488, $KP_{1,2}$ upper; fig. 29: GN 5476, $KP_{1,2}$ middle.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Explanation of plate 17
(All figures magnified X 1000)

Fig. 1. *Intrabaculitricolporites* sp. a
GN 5436, KM_3 Merkez Munja.

Fig. 2. *Cyrillaceaepollenites megaexactus* (Potonié) Potonié
GN 5486, $KP_{1,2}$ upper.

Fig. 3. *Intrabaculitricolporites ellipsoideus* (Takahashi & Jux) n. comb.
GN 5451, KM_3 Kisrakdere W.

Fig. 4. *Cupuliferoipollenitres* sp.
GN 5401, $KM_{1,2}$ lower.

Figs. 5, 6, 9. *Intrabaculitricolporites* sp. b
Figs. 5, 6: GN 5466, $KP_{1,2}$ lower; fig. 9: GN 5401, $KM_{1,2}$ lower.

Figs. 7, 8. *Cupuliferoipollenitres fusus* (Potonié) Takahashi & Jux
Fig. 7: GN 5476, $KP_{1,2}$ middle; fig. 8: GN 5401, $KM_{1,2}$ lower.

Fig. 10. *Tricolporopollenites* sp. a
GN 5476, $KM_{1,2}$ middle.

Fig. 11. *Tricolporopollenites* cf. *turcianus* n. sp.
GN 5476, $KP_{1,2}$ middle.

Fig. 12. *Tricolporopollenites* sp. b
GN 5422, $KM_{1,2}$ upper.

Fig. 13. *Tricolporopollenites pseudochagrenatus* Takahashi & Jux
GN 5488, $KP_{1,2}$ upper.

Fig. 14. *Tricolporopollenites* sp. c
GN 5401, $KM_{1,2}$ lower.

Fig. 15. *Tricolporopollenites* sp. d
GN 5466, $KP_{1,2}$ lower.

Fig. 16. *Tricolporopollenites* sp. e
GN 5476, $KP_{1,2}$ upper.

Fig. 17. *Tricolporopollenites* sp. f
GN 5486, $KP_{1,2}$ upper.

Fig. 18. *Striatocolporites* sp. a
GN 5487, $KP_{1,2}$ upper.

Fig. 19. *Striatocolporites* sp. b
GN 5421, $KM_{1,2}$ upper.

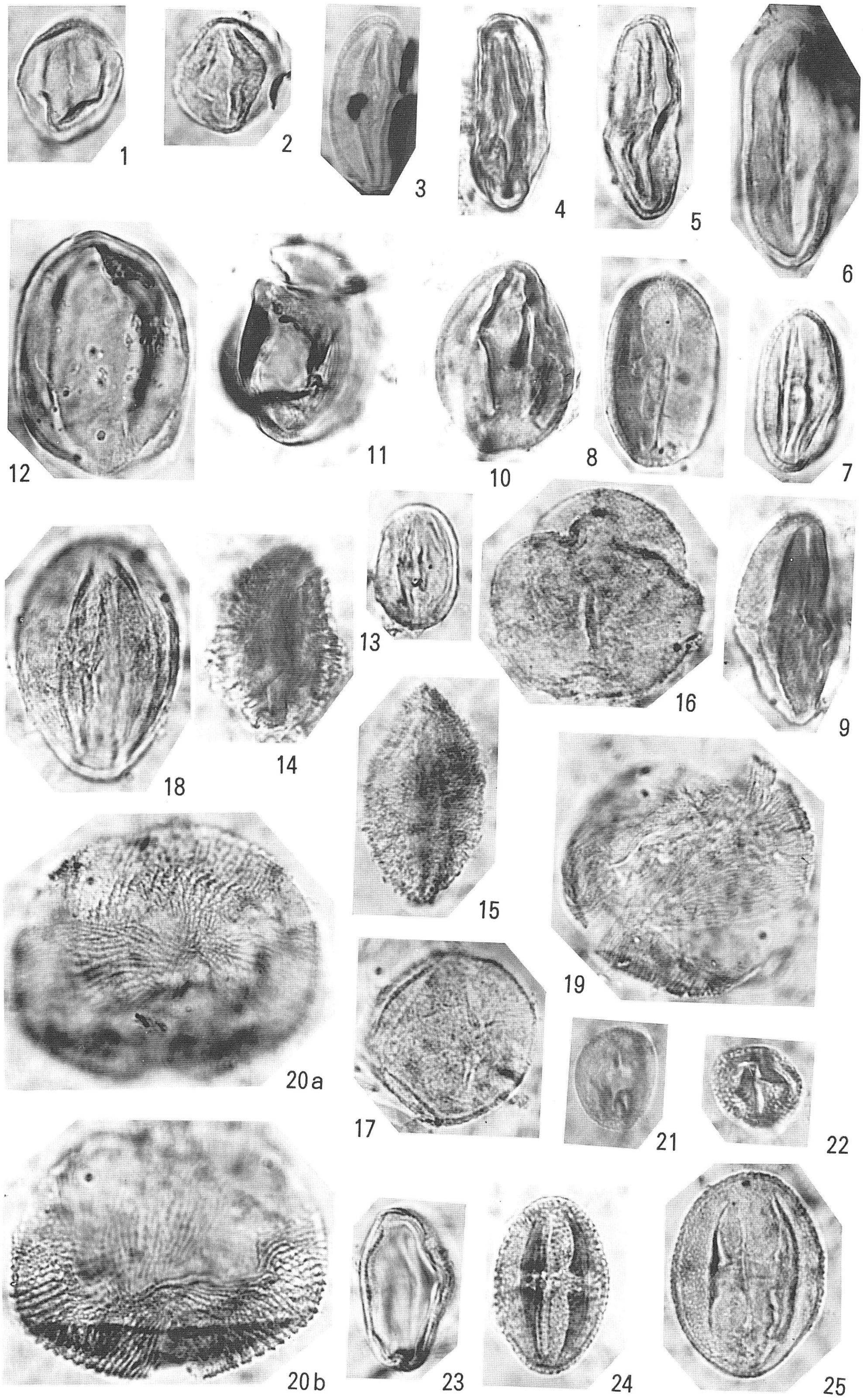
Figs. 20 a—b. *Striatocolporites ovuliformis* Takahashi & Jux
GN 5476, $KP_{1,2}$ middle.

Figs. 21, 22. *Rhoipites minus* Takahashi & Jux
GN 5401, $KM_{1,2}$ lower.

Fig. 23. *Rhoipites mirus* Takahashi & Jux
GN 5476, $KP_{1,2}$ middle.

Fig. 24. *Rhoipites finitus* (González Guzmán) Takahashi & Jux
GN 5477, $KP_{1,2}$ middle.

Fig. 25. *Rhoipites* sp. a
GN 5488, $KP_{1,2}$ upper.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Explanation of plate 18
(All figures magnified X 1000)

Figs. 1a–b. *Rhoipites* sp. b
GN 5401, $KM_{1,2}$ lower.

Fig. 2. *Rhoipites rotundus* Takahashi & Jux
GN 5412, $KM_{1,2}$ middle.

Fig. 3. *Rhoipites retiformis* Rocknall & Mildenhall
GN 5401, $KM_{1,2}$ lower.

Fig. 4. *Rhoipites* cf. *bradleyi* Wodehouse
GN 5466, $KP_{1,2}$ lower.

Figs. 5–10. *Ilexpollenites tertiarius* (Takahashi) Takahashi
Figs. 5, 9: GN 5401, $KM_{1,2}$ lower; fig. 6: GN 5451, KM_3 Kisrakdere W.; figs. 7, 8, 10: GN 5466, $KP_{1,2}$ lower.

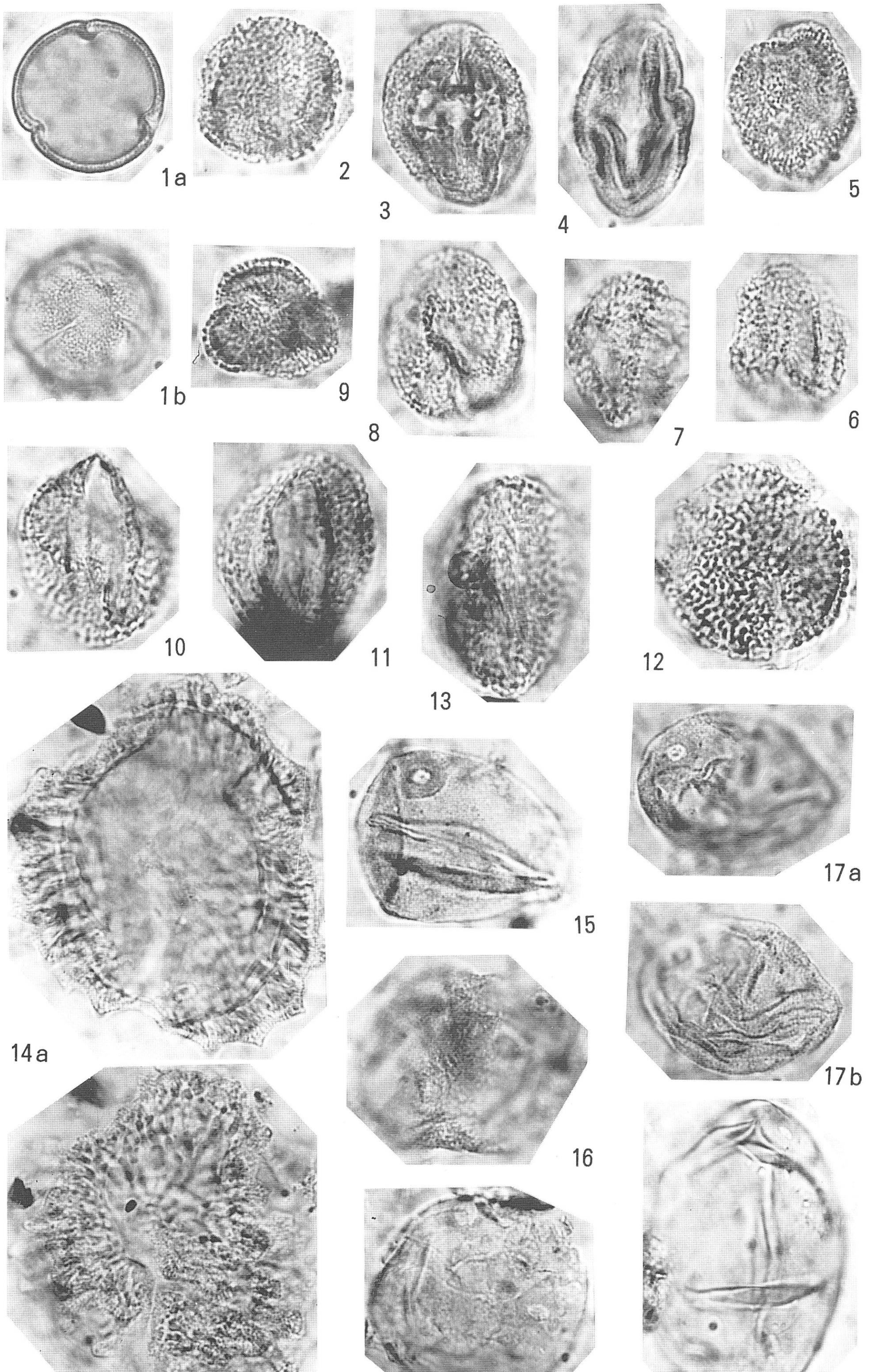
Figs. 11–13. *Ilexpollenites margaritatus* (Potonié) Raatz: ex Potonié
Figs. 11, 13: GN 5466, $KP_{1,2}$ lower; fig. 12: GN 5476, $KP_{1,2}$ middle.

Figs. 14a–b. *Compositoipollenites denizliensis* (Nakoman) n. comb.
GN 5466, $KP_{1,2}$ lower.

Figs. 15, 16, 17a–b. *Graminidites subtiliglobosus* (Trevisan) Krutzsch
Fig. 15: GN 5468, $KP_{1,2}$ lower; fig. 16: GN 5466, $KP_{1,2}$ lower; figs. 17a–b: GN 5421, $KM_{1,2}$ upper.

Fig. 18. *Graminidites* cf. *leavigatus* Krutzsch
GN 5486, $KP_{1,2}$ upper,

Fig. 19. *Graminidites* sp.
GN 5412, $KM_{1,2}$ middle.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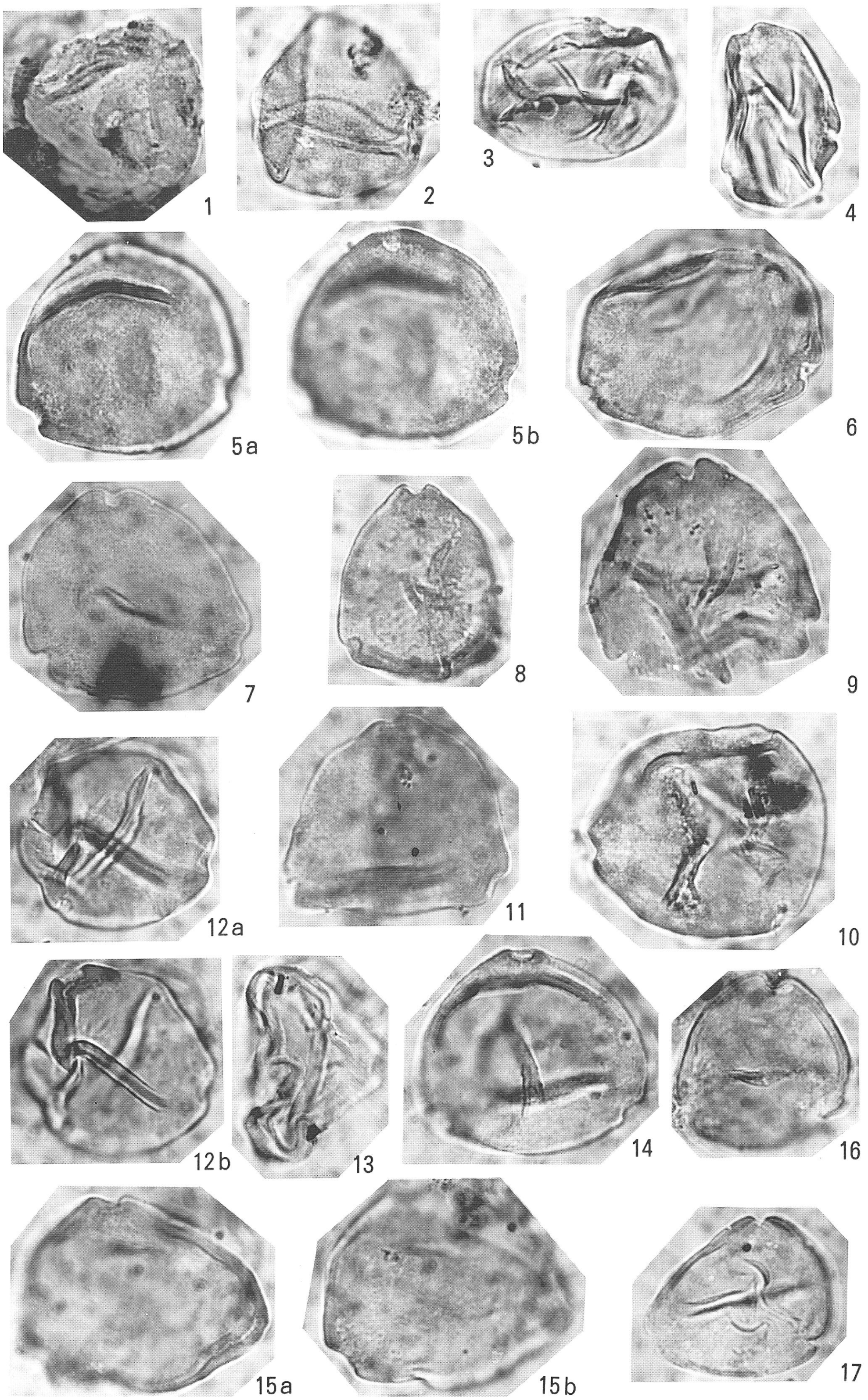
Explanation of plate 19
(All figures magnified X 1000)

Figs. 1—3.	*Graminidites laevigatus* Krutzsch Fig. 1: GN 5451, KM_3 Kisrakdere W.; figs. 2, 3: GN 5476, $KP_{1,2}$ middle.
Figs. 4—7.	*Triatriopollenites rurensis* Pflug & Thomson Fig. 4: GN 5436, KM_3 Merkez Munja; figs. 5a—b: GN 5401, $KM_{1,2}$ lower; figs. 6, 7: GN 5466, $KP_{1,2}$ lower.
Figs. 8, 9.	*Triatriopollenites pseudorurensis* Pflug Fig. 8: GN 5401, $KM_{1,2}$ lower; fig. 9: GN 5421, $KM_{1,2}$ upper.
Figs. 10—15.	*Triatriopollenites subfragilis* Takahashi & Jux Figs. 10, 12a—b, 14, 15a—b: GN 5401, $KM_{1,2}$ lower; fig. 11: GN 5421, $KM_{1,2}$ upper; fig. 13: GN 5451, KM_3 Kisrakdere W
Fig. 16.	*Triatriopollenites* sp. GN 5466, $KP_{1,2}$ lower.
Fig. 17.	*Engelhardtioipollenites punctatus* (Potonié) Potonié ex Potonié GN 5466, $KP_{1,2}$ lower.



Explanation of plate 20
(All figures magnified X 1000)

Figs. 1–6. *Engelhardtioipollenites punctatus* (Potonié) Potonié ex Potonié
Fig. 1: GN 5452, KM_3 Kisrakdere W.; fig. 2: GN 5476, $KP_{1,2}$ middle; figs 3, 6: GN 5466, $KP_{1,2}$ lower; fig. 4: GN 5421, $KM_{1,2}$ upper; fig. 5: GN 5401 $KM_{1,2}$ lower

Figs. 7, 10. *Triporopollenites subfragilis* Takahashi & Jux
Fig. 7: GN 5422, $KM_{1,2}$ upper; fig. 10: GN 5486, $KP_{1,2}$ upper.

Figs. 8, 9. *Engelhardtioidites microcoryphaeus* (Potonié) Potonié , Thomson & Thiergart ex Potonié
Fig. 8: GN 5466, $KP_{1,2}$ lower; fig. 9: GN 5401, $KM_{1,2}$ lower.

Figs. 11, 12. *Triporopollenites shimensis* Takahashi
Fig. 11: GN 5476, $KP_{1,2}$ middle; fig. 12: GN 5466, $KP_{1,2}$ lower.

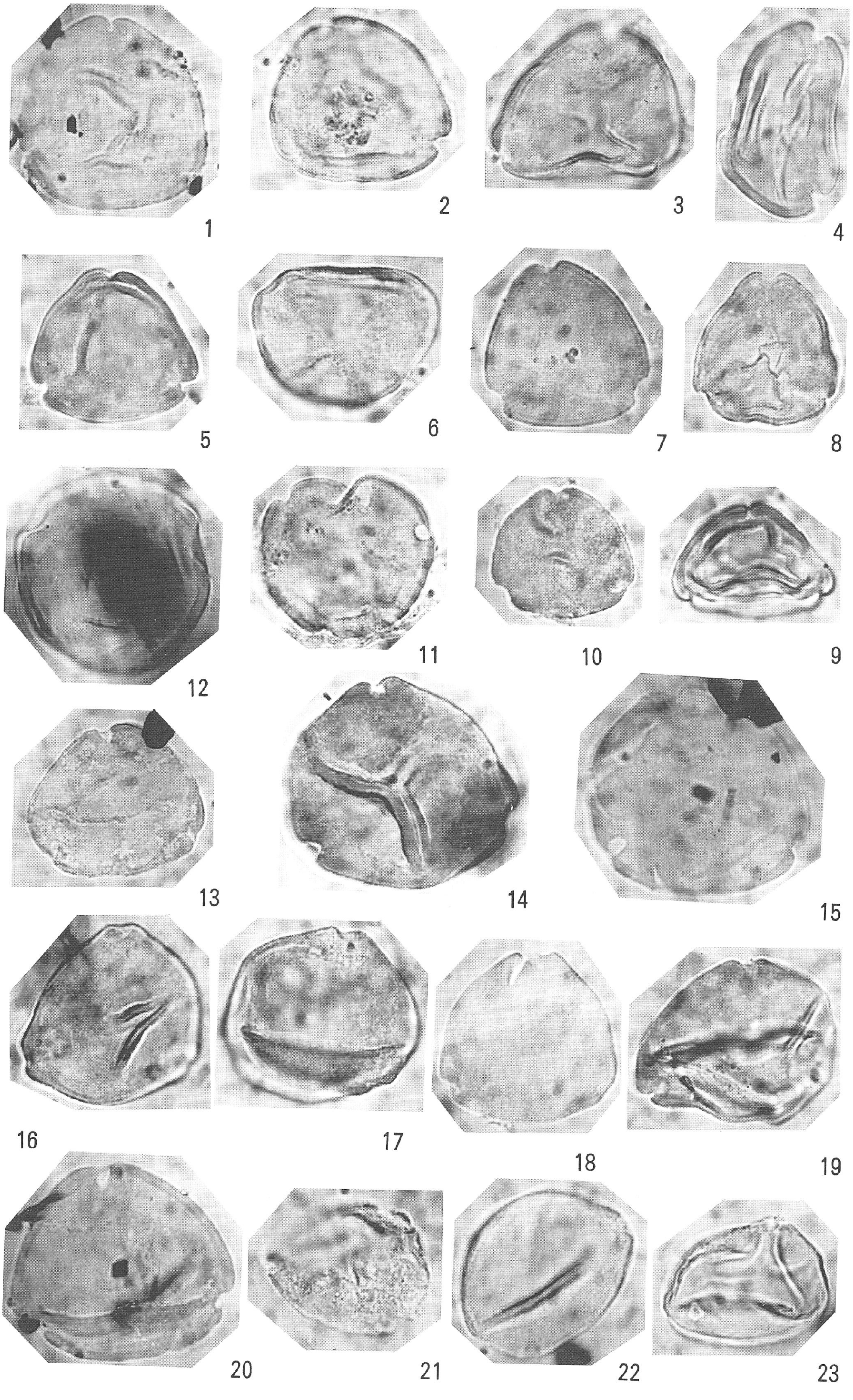
FIg. 13. *Triporopollenites* sp.
GN 5437. KM_3 Merkez Munja.

Figs. 14, 15, 20. *Momipites somaensis* n. sp.
Fig. 14: GN 5401. $KM_{1,2}$ lower; fig. 15: GN 5451, KM_3 Kisrakdere W.; fig 20: holotype, GN 5452, KM_3 Kisrakdere W.

Figs. 16–19. *Triporopollenites moderatus* n. sp.
Figs. 16, 17, 19: GN 5401, $KM_{1,2}$ lower; fig. 16: holotype; fig. 18: GN 5437, KM_3 Merkez Munja.

Fig. 21. *Momipites* sp.
GN 5436, KM_3 Merkez Munja.

Figs. 22, 23. *Subtriporopollenites kyushuensis* Takahashi
GN 5436, KM_3 Merkez Munja.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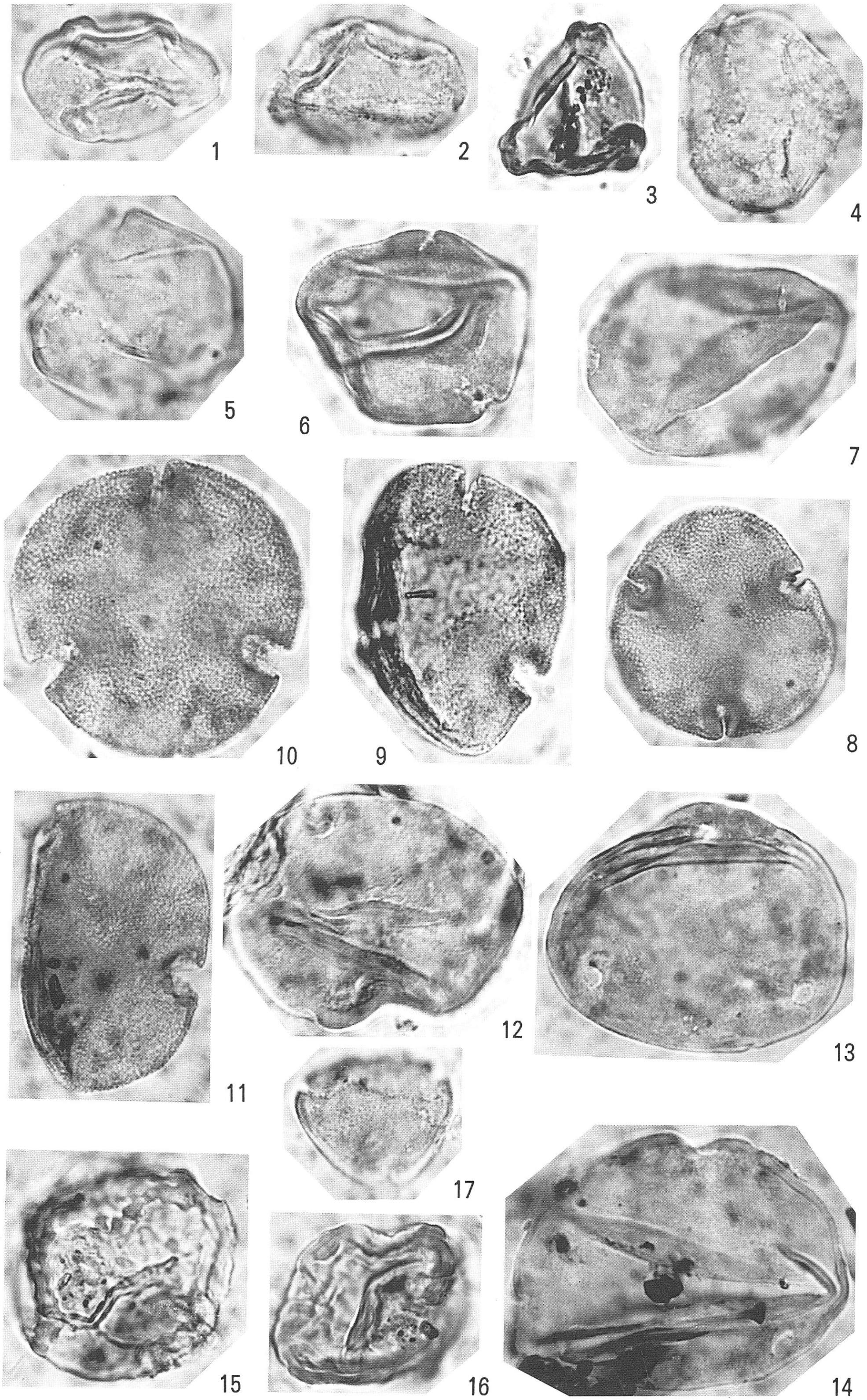
Explanation of plate 21
(All figures magnified X 1000)

Figs. 1, 2.	*Betulaepollenites* sp. Fig. 1: GN 5421, $KM_{1,2}$ upper; fig. 2: GN 5466, $KP_{1,2}$ lower.
Fig. 3.	*Trivestibulopollenites betuloides* Pflug GN 5423, $KM_{1,2}$ upper.
Figs. 4–7.	*Subtriporopollenites kyushuensis* Takahashi Figs. 4, 5: GN 5466, $KP_{1,2}$ lower; figs. 6, 7: GN 5402, $KM_{1,2}$ lowe1
Figs. 8–11.	*Tiliaepollenites instructus* Potonié ex Potonié & Venitz GN 5401, $KM_{1,2}$ lower.
Figs. 12–14.	*Caryapollenites simplex* (Potonié) Raatz *simplex* Fig. 12: GN 5488, $KP_{1,2}$ upper; fig. 13:5401, $KM_{1,2}$ lower; fig. 14: GN 5454, KM_3 Kisrakdere W.
Fig. 15.	*Ulmipollenites undulosus* Wolff GN 5401, $KM_{1,2}$ lower.
Fig. 16.	*Zelkovaepollenites potoniei* Nagy GN 5401, $KM_{1,2}$ lower.
Fig. 17.	*Tricolpopollenites* sp. b GN 5476, $KP_{1,2}$ middle.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Explanation of plate 22

(All figures magnified X 1000)

Figs. 1−3, 5, 6. *Zelkovaepollenites potoniei* Nagy
Fig. 1: GN 5412, $KM_{1,2}$ middle; fig. 2, 5: GN 5452, KM_3 Kisrakdere W,; fig. 3, 6: GN 5466, $KP_{1,2}$ lower.

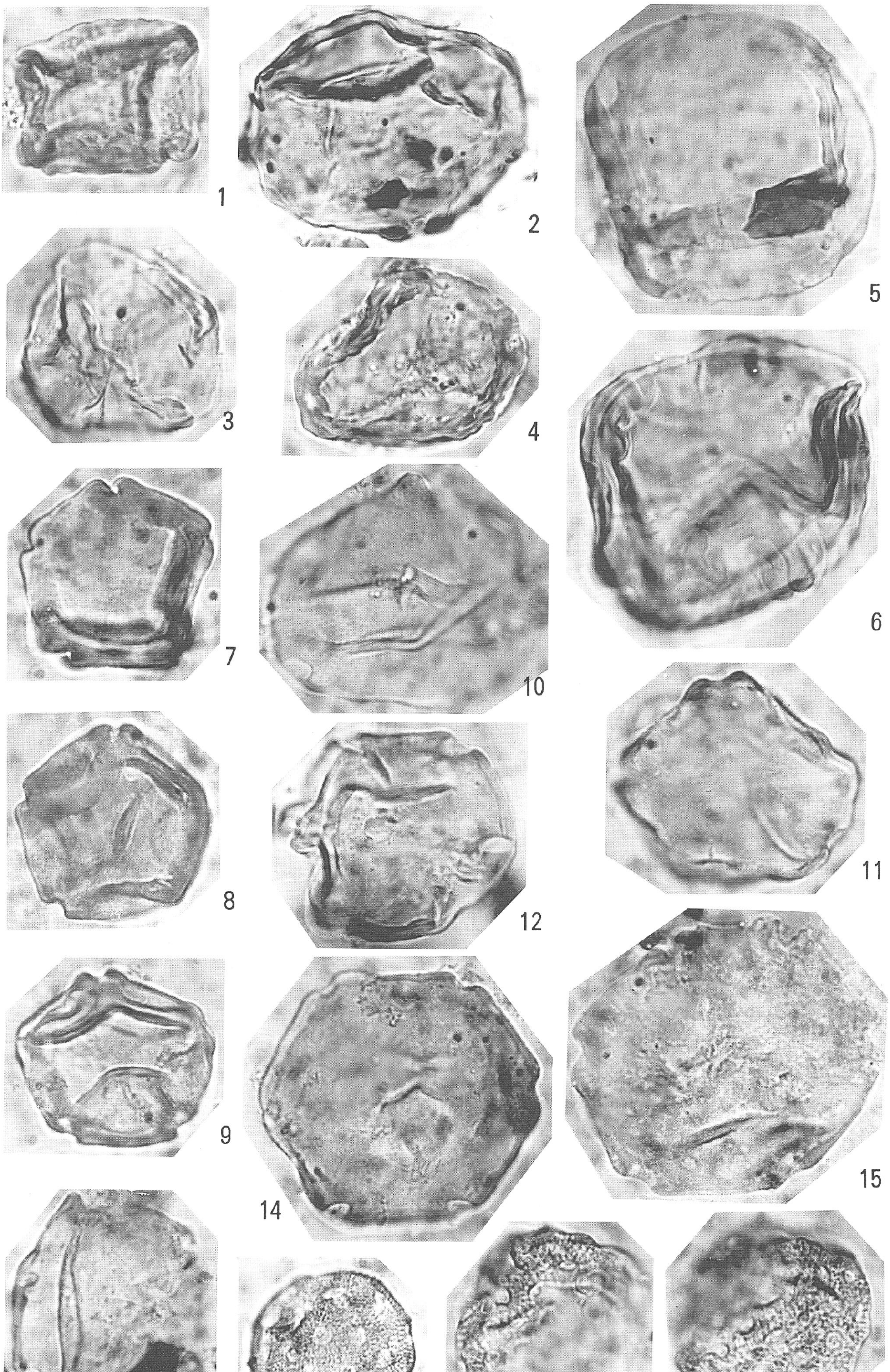
Fig. 4. *Ulmipollenites undulosus* Wolff
GN 5421, $KM_{1,2}$ upper.

Figs. 7−9. *Polyvestibulopollenites verus* (Potonié) Thomson & Pflug
Figs. 7, 8: GN 5401. $KM_{1,2}$ lower; fig. 9: GN 5411, $KM_{1,2}$ middle.

Figs. 10, 11. *Carpinuspollis carpinoides* (Pflug) Takahashi
Fig. 10: GN 5421, $KM_{1,2}$ upper; fig. 11: GN 5466, $KP_{1,2}$ lower.

Figs. 12−15. *Polyatriopollenites stellatus* (Potonié) Pflug
Figs. 12, 13: GN 5466, $KP_{1,2}$ lower; fig. 14: 5421, $KM_{1,2}$ upper; fig. 15: GN 5423, $KM_{1,2}$ upper.

Figs. 16, 17a −b. *Chenopodipollis multiplex* (Weyland & Pflug) Krutzsch
Fig. 16: GN 5476, $KP_{1,2}$ middle; figs. 17a −b: GN 5466, $KP_{1,2}$ lower.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Explanation of plate 23

(All figures magnified X 1000 unless otherwise mentioned)

Figs. 1, 2.	*Ovoidites lanceolatus* n. sp.
	Fig. 1: holotype, GN 5437, KM_3 Merkez Munja; fig. 2: GN 5486, $KP_{1,2}$ upper.
Fig. 3.	*Schizosporis cooksoni* Pocock
	GN 5487, $KP_{1,2}$ upper.
Fig. 4.	*Schizosporis* cf. *parvus* Cookson & Dettmann
	GN 5487, $KP_{1,2}$ middle.
Fig. 5.	*Ovoidites raatzi* Nakoman
	GN 5467, $KP_{1,2}$ lower.
Figs. 6–8.	*Ovoidites pseudoligneolus* Krutzsch
	Fig. 6: GN 5468, $KP_{1,2}$ lower; fig. 7: GN 5466, $KP_{1,2}$ lower; fig. 8: GN 5467, $KP_{1,2}$ lower.
Figs. 9, 10.	*Schizosporis ellipsoideus* n. sp.
	Fig. 9: GN 5468, $KP_{1,2}$ lower; fig. 10: holotype, GN 5488, $KP_{1,2}$ upper


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